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MINERAL RESOURCES
OF THE
UNITED STATES
1929

PART I—METALS

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U. S. DEPARTMENT OF COMMERCE
R. P. LAMONT, Secretary
BUREAU OF MINES
SCOTT TURNER, Director

MINERAL RESOURCES
OF THE
UNITED STATES
1929

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PART I—METALS

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MINERAL RESOURCES OF THE UNITED STATES, 1929—PART I

THE MINERAL RESOURCES OF THE UNITED STATES IN 1929[1]

INTRODUCTION

By O. E. Kiessling

Chief Economist, Division of Mineral Statistics

This report, the forty-seventh of an annual series, is published in two parts. Part I contains a general summary of all mineral products, the prefatory note to the chapters on gold, silver, copper, lead, and zinc giving average prices at which values of the metals are calculated, and 31 chapters of which 15 are State or regional reports relating to gold, silver, copper, lead, and zinc mining and 16 are general reports on various metals or metalliferous mineral products. Part II consists of 30 chapters, each relating to one, or a group, of the nonmetallic mineral products, including the mineral fuels—coal, oil, and gas.

The summary which constitutes the first chapter of Part I comprises: (1) General summary tables of production; (2) detailed tables giving data on domestic production and on imports and exports of the various minerals, arranged in alphabetic order, for a series of years, and giving data on consumption, stocks, etc., for some important products; (3) State tables in alphabetic order. Thus, it is a recapitulation of the statistical material contained in both volumes of Mineral Resources of the United States.

Unit of measurement.—The unit of measurement used by the Bureau of Mines for each mineral product in the reports on the mineral resources is that common to the industry concerned, and the variation in these units makes it impracticable, if not impossible, directly to combine and compare the different minerals except as to value, especially because some products are measured by volume, although most are measured by weight.

Elimination of duplication.—In the totals for the United States, shown in the following general tables, duplication has been eliminated wherever practicable, and in the State totals given in the State tables virtually all duplication has been eliminated. For instance, in both general and State tables the output of coke is shown, but its value is not included in the totals, as the value of the coal used in its manufacture enters into the value of the coal production, which is included in the totals. The value of the products of the clay industries is included in both general and State totals as representing the first marketable form of the greater part of the clay produced; the quantity and value of the clay mined and sold in the raw state by miners to users of clay are shown separately, but the value is not included in the totals.

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[1] In Mineral Resources of the United States the use of leaders (----) indicates that so far as the Bureau of Mines has been able to ascertain there was nothing to report. If data are not available, the fact is indicated by a statement to that effect in a footnote. Leaders are also used in footings where it is quite evident that figures in a column are not addable and in other places where entries are not appropriate.

All figures of imports and exports in this report, unless otherwise stated, were compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce, having been converted by Mr. Dorsey to the various units of measurement used in this report and arranged by him in their present form. The imports are those for the calendar year unless otherwise stated. Wherever exports are shown, unless otherwise specified, the figures represent domestic products and not foreign minerals reexported, and they also cover calendar years.

In the general tables both iron ore and pig iron are shown, but the value of the pig iron rather than that of the iron ore is included in the totals, as that is considered the better means of presenting the statistics for iron in its first marketable form. For gold, silver, copper, lead, and zinc the value of "smelter output" is included in the general totals, and in order to account more fully for the value of the ores treated these smelter figures are supplemented by the value of the by-product sulphuric acid. The value of pigments (white lead, red lead, lithopone, litharge, and orange mineral) manufactured from metals is not included in the general tables, as the base from which they are made is included in the output of lead or zinc, whereas the value of sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide is included, as these are made in large part direct from the ores and do not enter into the lead or zinc totals, which represent smelter output.

In the State tables also iron ore and pig iron are both shown. As blast-furnace products can not be distributed according to the States in which the ore is mined, the value of the ore is used in the State totals. For ores of gold, silver, copper, lead, and zinc no values are shown, and in fact none are recorded; instead, for each of these metals the recoverable content of the ores is used as the basis of valuation. The value of the zinc and lead pigments is not included in the State total, as the recoverable zinc and lead content of the ores from which the products were made is included under zinc or lead. The value of the sulphuric acid produced as a by-product of copper and zinc smelting is not included in the State total, as tracing this product back to the State producing the ore has not been possible.

SALIENT FEATURES OF 1929 STATISTICS

The value of all mineral products in 1929 was $5,887,300,000, or 9 per cent greater than the value in 1928. The upward trend was, however, neither general nor uniform and did not bring the total to preceding high levels of the last decade—$6,213,600,000 in 1926, a year of marked prosperity, and $5,986,500,000 in 1923 and $6,981,340,000 in 1920, two years of high price levels. Comparisons for the major groups of mineral industries show that the total value of metals produced in 1929 has been exceeded only twice—in 1923 and 1920—in the past decade; that the total value of all nonmetallic products, except fuels, was less in 1929 than in any year of the decade except 1928 and the first three; and that the total value of all mineral fuels in 1929 surpassed that for each year of the decade except 1926, 1923, and 1920.

The mineral fuels as a group show an increase of about 11 per cent in total value of products, attributable chiefly to a large gain in the value of petroleum produced and commensurate gains in the value of natural gas and natural gasoline, whereas the value of the bituminous coal output increased only moderately and the value of anthracite decreased. However, the moderate increases in 1929 in the quantity and value of bituminous coal mined are noteworthy, as they follow two years of declining output. Petroleum production passed the 1,000,000,000-barrel mark in 1929, an increase of nearly 12 per cent over 1928. The value of the year's output increased in even greater ratio, despite the accumulation of stocks due to the extraordinary rate of production in the first half of the year. The sales of natural gas and natural gasoline continued strong in growth throughout 1929.

The total value of metallic products of the mines of the United States was nearly 15 per cent greater in 1929 than in 1928. Except for gold and silver, all the important metals contributed to this increase, of which nearly one-half was accounted for by a great increase in the value of copper. Whereas the smelter output of copper in the United States increased 10 per cent the total value increased 34 per cent; the average price for the year was higher by 3.2 cents per pound, or 22 per cent, than that for 1928. Production and consumption of copper continued at a high rate throughout 1929, but production so far outdistanced consumption as to cause an accumulation of stocks of refined copper at the end of the year of more than two and one-half times the stocks at the beginning. This condition was followed by recession in both price and buying after the close of the first quarter of 1930. In lesser degree the lead, zinc, and aluminum industries also benefited by increased output and higher price levels in 1929 as compared with 1928. The production of steel reached a new high level, exceeding 1928 production by about 9 per cent, and concomitantly shipments of pig iron reached a new peak total of 8 per cent in quantity above 1928. Although not keeping pace with the outputs of steel and pig iron, the shipments of iron ore were 19 per cent greater in 1929 than in 1928. Values of both pig iron and iron ore also averaged higher in 1929 than in 1928. The production of high-grade manganese ore in 1929 was greater than in any year since 1925 by reason of sustained operation of a process of beneficiating carbonate ores. The production of mercury was nearly one-third greater in quantity and value in 1929 than in 1928 and was the largest annual output since 1918. Gold production declined by about 1 per cent. The quantity of silver produced increased moderately, but the average and total value decreased.

The total value of nonmetallic products (not including fuels) increased less than 1 per cent in 1929 as the result not only of decline in quantity of production of a number of important items but also by reason of generally lower price levels for nonmetallic products. The small increase in the total is due to the preponderance of the structural materials, in the use of which there was recession in 1929, whereas most of the chemical, metallurgical, and other industrial mineral materials show increases. Among the structural materials stone and sand and gravel increased in both quantity and total value. Production of lime, cement, gypsum, and structural clay products all decreased between 2 and 5 per cent in quantity and 2 and 9 per cent in value.

Sales of raw clay, largely by reason of demand from metallurgical industries, showed an increase of 8 per cent in volume but of only 5 per cent in value. Production of other ceramic materials—feldspar and silica—decreased. Shipments of phosphate rock for export in 1929 were the largest in 25 years; the total shipments increased 7 per cent in quantity but only 6 per cent in value compared with 1928. Sales of potassium salts (equivalent as K_2O) decreased 5 per cent in quantity and 1 per cent in value in 1929. The output of salt, fluorspar, barite, fuller's earth, and mica increased moderately or slightly in 1929, while sulphur, arsenic, and magnesite made large gains.

STATISTICAL SUMMARY

By Martha B. Clark

GENERAL TABLES

Mineral products of the United States, 1928 and 1929 [1]

Product	1928		1929	
	Quantity	Value	Quantity	Value
METALLIC				
Aluminum____pounds__	210,000,000	$47,899,000	225,000,000	$51,864,000
Antimonial lead [2]___short tons (2,000 pounds)__	33,058	3,978,318	25,669	3,267,095
Antimony [3]____do____	3,432	707,000	3,052	545,700
Bauxite____long tons (2,240 pounds)__	375,426	2,273,898	365,777	2,265,638
Cadmium____pounds__	1,875,896	1,144,297	2,481.427	2,009,956
Chromite____long tons__	660	14,807	269	3,976
Copper,[4] sales value____pounds__	1,825,900,393	262,930,000	2,002,863,135	352,504,000
Ferro-alloys____long tons__	794,695	66,578,039	829,324	75,506,078
Gold [5]____troy ounces__	2,233,251	46,165,400	2,208,386	45,651,400
Iron:				
Ore [6]____long tons__	63,432,826	[6] 155,788,657	75,602,734	[6] 197,148,640
Pig____do____	38,303,699	661,351,270	41,549,161	731,858,075
Lead (refined),[4] sales value____short tons__	626,202	72,639,000	672,498	84,735,000
Manganese ore (35 per cent or more Mn)____long tons__	46,860	1,214,853	60,379	1,612,357
Manganiferous ore (5 to 35 per cent Mn) [7]____long tons__	1,177,632	3,053,307	1,188,258	3,274,466
Mercury:				
Metal____flasks (76 pounds net)__	17,870	2,207,003	23,682	2,892,638
Ore____short tons__	(8)	(9)	(8)	(9)
Nickel (value at New York City)____do____	522	291,836	340	297,273
Ores (crude), tailings, etc.:				
Copper____do____	62,125,000	(9)	68,422,000	(9)
Copper-lead and copper-lead-zinc____do____	351,000	(9)	259,000	(9)
Dry and siliceous (gold and silver)____do____	8,095,000	(9)	7,671,000	(9)
Lead____do____	8,048,000	(9)	8,165,000	(9)
Lead-zinc____do____	13,379,000	(9)	14,469,000	(9)
Zinc____do____	5,855,000	(9)	7,193,000	(9)
Platinum and allied metals (value at New York City)____troy ounces__	59,039	4,692,786	47,977	3,121,471
Silver____do____	58,462,507	34,200,567	61,327,868	32,687,754
Tin (metallic equivalent)____short tons__	47	47,400	39	35,600
Titanium ore:				
Ilmenite____do____	(10)	(10)	(10)	(10)
Rutile____do____	(10)	(10)	(10)	(10)
Tungsten ore (60 per cent concentrates)__do____	1,208	753,900	830	654,000
Uranium and vanadium ores____do____	(10)	(10)	(10)	(10)
Zinc,[4] sales value____do____	591,525	72,166,000	612,136	80,802,000
Total value of metallic products (approximate)____	----------	1,284,580,000	----------	1,475,990,000
NONMETALLIC				
Arsenious oxide____short tons__	11,767	735,373	14,546	883,771
Asbestos____do____	2,239	351,178	3,155	351,004
Asphalt:				
Native____do____	807,860	5,175,055	804,027	5,470,493
Oil [6]____do____	[11] 1,930,536	[6] [11] 22,060,312	2,332,973	[6] 24,135,787
Barite (crude)____do____	269,544	1,754,924	277,269	1,850,706
Borates (colemanite and naturally occurring sodium borates)____short tons__	131,000	3,999,773	169,870	4,515,375
Bromine____pounds__	2,164,000	649,475	6,414,620	1,759,325
Calcium-magnesium chloride____short tons__	102,090	1,995,603	114,240	2,097,061
Cement____barrels (376 pounds net)__	178,051,977	278,883,042	172,027,452	255,104,506
Clay:				
Products [12]____	----------	373,550,882	----------	373,409,391
Raw [6]____short tons__	4,026,332	[6] 14,200,739	4,347,020	[6] 14,850,744
Coal:				
Bituminous [13]____do____	500,744,970	933,774,000	534,988,593	952,781,000
Pennsylvania anthracite____long tons__	67,275,062	393,637,690	65,918,031	385,642,751
Coke [6]____short tons__	52,805,828	[6] 252,833,760	59,883,845	[6] 278,994,592
Diatomite and tripoli [14]____do____	34,043	555,576	38,011	545,658
Emery____do____	1,341	16,787	924	10,722
Feldspar (crude)____long tons__	210,811	1,418,975	197,699	1,276,640
Fluorspar____short tons__	140,490	2,656,554	146,439	2,791,126
Fuller's earth____do____	287,012	3,895,991	315,983	4,309,723
Garnet for abrasive purposes____do____	6,617	459,307	5,961	435,420
Gems and precious stones____	----------	(15)	----------	(15)
Graphite:				
Amorphous____short tons__	2,994	43,320	3,555	46,650
Crystalline____pounds__	5,233,300	253,773	5,806,410	264,241
Grindstones and pulpstones____short tons__	33,238	1,508,837	27,736	1,241,546
Gypsum____do____	5,102,250	32,036,163	5,016,132	31,292,969
Lime____do____	4,458,412	36,449,635	4,269,768	33,478,848

Footnotes at end of table.

Mineral products of the United States, 1928 and 1929—Continued

Product	1928		1929	
	Quantity	Value	Quantity	Value
NONMETALLIC—continued				
Magnesite (expressed as equivalent crude) short tons	127,200	$1,098,550	187,660	$1,500,000
Mica:				
Scrap do	7,760	132,422	6,253	117,901
Sheet pounds	1,681,777	230,956	2,035,128	286,321
Millstones		42,886		31,407
Mineral paints:				
Natural pigments [16] short tons	(16)	(16)	(16)	(16)
Zinc and lead pigments [17] do	202,363	26,017,743	204,574	26,211,556
Mineral waters gallons sold	(15)	(15)	(15)	(15)
Natural gas M cubic feet	1,568,139,000	363,726,000	1,917,693,000	413,276,000
Natural gasoline gallons	1,814,034,000	138,944,000	2,233,688,000	158,410,000
Oilstones, etc short tons	956	228,245	838	212,017
Peat do	(15)	(15)	(15)	(15)
Petroleum barrels (42 gallons)	901,474,000	1,054,880,000	1,007,323,000	1,280,417,000
Phosphate rock long tons	3,501,406	12,443,179	3,760,855	13,153,259
Potassium salts short tons	[18] 60,370	3,029,422	[18] 57,540	2,988,448
Pumice do	57,430	278,516	60,873	318,579
Pyrites [19] long tons	312,815	1,081,758	333,465	1,250,141
Salt short tons	8,074,700	26,772,568	8,543,560	27,334,695
Sand:				
Glass do	2,310,828	3,435,645	2,219,677	3,788,471
Molding, building, etc., and gravel do	206,808,040	115,772,292	220,352,228	129,047,508
Sand-lime brick [12] thousands	313,553	3,654,590	269,584	2,909,635
Silica (quartz) short tons	22,198	209,333	20,981	205,759
Slate do	646,360	11,472,291	670,070	11,245,178
Stone do	133,869,510	196,820,697	141,109,580	202,692,762
Sulphur long tons	2,082,924	37,500,000	2,437,238	43,800,000
Sulphuric acid (60° Baumé) from copper and zinc smelters short tons	1,140,268	9,007,809	1,239,842	9,828,004
Talc and soapstone [20] do	202,976	2,537,994	219,783	2,628,662
Total value of nonmetallic products (approximate)		4,091,620,000		4,400,880,000
SUMMARY				
Total value of metallic products		1,284,580,000		1,475,990,000
Total value of nonmetallic products (exclusive of mineral fuels)		1,206,658,000		1,210,353,000
Total value of mineral fuels		2,884,962,000		3,190,527,000
Total value of "unspecified" (metallic and nonmetallic) products (partly estimated) [21]		9,000,000		[21] 10,430,000
Grand total approximate value of mineral products		5,385,200,000		5,887,300,000

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[1] In this general statement certain of the figures represent shipments rather than quantity mined. The reader is referred to the following sections on the various mineral products for information in greater detail than it seems practicable to give here.

[2] From both domestic and foreign ores.

[3] Figures represent antimony content of antimonial lead. Value excluded from metallic total as the value of the antimony is included in the antimonial lead value. Value for antimony other than that in antimonial lead is included in metallic total; Bureau of Mines not at liberty to publish figures.

[4] Product from domestic ores only.

[5] Value, $20.671834625323 an ounce.

[6] Value not included in total value.

[7] Including ore used for fluxing. For separation see pp. A59 and A60.

[8] Figures not available.

[9] Figures showing values not available.

[10] Value included in total value of metallic products; Bureau of Mines not at liberty to publish figures.

[11] Revised figures.

[12] Figures obtained through cooperation with Bureau of the Census.

[13] Includes brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania.

[14] Figures represent tripoli only. Value of diatomite is included in total value of nonmetallic products; Bureau of Mines not at liberty to publish figures.

[15] No canvass. Estimate of value included in total value of nonmetallic products.

[16] Canvass discontinued after 1915. Value of iron ore sold for paint included under last item ("Unspecified").

[17] Sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.

[18] Equivalent as K_2O.

[19] Figures include pyrites concentrates from Tennessee and partly desulphurized tailings from zinc operations in Wisconsin.

[20] Figures represent talc only. Value of soapstone is included in total value of nonmetallic products; Bureau of Mines not at liberty to publish figures.

[21] Includes for 1929 the value of bismuth, cadmium compounds ($498,734), chats ($558,600), columbite ($17,261), flint lining for tube mills and pebbles for grinding ($66,178), optical fluorspar, gem feldspar ($2,200), iron ore sold for magnets, iron ore sold for paint ($90,352), lithium minerals, new ingot magnesium ($512,313), natural magnesium hydrate (brucite) ($774), natural magnesium salts ($1,081,817), calcareous marl ($130,866), greensand marl ($255,680), micaceous minerals ($96,028), molybdenum ($2,259,000), selenium ($568,265), silica sand and sandstone (finely ground) ($1,267,306), sodium salts (carbonate, bicarbonate, sulphate, and trona) from natural sources ($1,957,831), tellurium ($2,710), and an estimate of the value of miscellaneous mineral products, statistics for which are not collected annually by the Bureau of Mines.

Value of mineral products of the United States, 1880–1929

Year	Metallic		Nonmetallic		Unspecified (metallic and nonmetallic)	Total	
	Value	Percentage of increase or decrease	Value	Percentage of increase or decrease		Value	Percentage of increase or decrease
1880	$187,881,000	--------	$173,582,000	--------	$6,000,000	$367,463,000	--------
1881	189,413,000	+0.8	207,207,000	+19	6,500,000	403,120,000	+10
1882	215,820,000	+14	230,786,000	+11	6,500,000	453,106,000	+12
1883	197,881,000	−8	243,680,000	+6	6,500,000	448,061,000	−1
1884	180,284,000	−9	221,756,000	−9	5,000,000	407,040,000	−9
1885	172,218,000	−4	242,333,000	+9	5,000,000	419,551,000	+3
1886	204,400,000	+19	250,995,000	+4	790,000	456,185,000	+9
1887	240,791,000	+18	294,057,000	+17	785,000	535,633,000	+17
1888	242,010,000	+.5	310,889,000	+6	900,000	553,799,000	+3
1889	250,325,000	+3	291,004,000	−6	997,000	542,326,000	−2
1890	303,440,000	+21	310,995,000	+7	994,000	615,429,000	+13
1891	280,485,000	−8	319,364,000	+3	1,000,000	600,849,000	−2
1892	283,715,000	+1	337,517,000	+6	1,000,000	622,232,000	+4
1893	223,154,000	−21	321,339,000	−5	1,000,000	545,493,000	−12
1894	186,835,000	−16	362,410,000	+13	1,000,000	550,245,000	+.9
1895	248,033,000	+33	393,658,000	+9	1,000,000	642,691,000	+17
1896	252,075,000	+2	387,966,000	−1	1,000,000	641,041,000	−.3
1897	269,934,000	+7	380,678,000	−2	1,000,000	651,612,000	+2
1898	308,247,000	+14	417,795,000	+10	1,000,000	727,042,000	+12
1899	483,521,000	+57	525,575,000	+26	1,000,000	1,010,096,000	+39
1900	513,732,000	+6	594,204,000	+13	1,000,000	1,108,936,000	+10
1901	493,314,000	−4	660,764,000	+11	1,000,000	1,155,078,000	+4
1902	604,517,000	+23	722,434,000	+9	1,000,000	1,327,951,000	+15
1903	588,753,000	−3	905,628,000	+25	1,000,000	1,495,381,000	+13
1904	501,114,000	−15	857,667,000	−5	400,000	1,359,181,000	−9
1905	702,585,000	+40	920,780,000	+7	400,000	1,623,765,000	+19
1906	886,180,000	+26	1,014,500,000	+10	200,000	1,900,880,000	+17
1907	904,108,000	+2	1,165,376,000	+15	86,000	2,069,570,000	+9
1908	550,768,000	−39	1,040,761,000	−11	244,000	1,591,773,000	−23
1909	754,944,000	+37	1,131,866,000	+9	297,000	1,887,107,000	+19
1910	749,879,000	−.7	1,237,668,000	+9	297,000	1,987,844,000	+5
1911	680,907,000	−9	1,242,942,000	+.4	232,000	1,924,081,000	−3
1912	862,008,000	+27	1,375,420,000	+11	366,000	2,237,794,000	+16
1913	878,869,000	+2	1,554,298,000	+13	378,000	2,433,545,000	+9
1914	686,639,000	−22	1,424,063,000	−8	470,000	2,111,172,000	−13
1915	991,730,000	+44	1,400,484,000	−2	2,430,000	2,394,644,000	+13
1916	1,620,745,000	+63	1,884,413,000	+35	3,281,000	3,508,439,000	+47
1917	2,086,234,000	+29	2,900,462,000	+54	5,800,000	4,992,496,000	+42
1918	2,153,318,000	+3	3,380,690,000	+17	6,700,000	5,540,708,000	+11
1919	1,359,744,000	−37	3,232,626,000	−4	3,400,000	4,595,770,000	−17
1920	1,762,350,000	+30	5,214,170,000	+61	4,820,000	6,981,340,000	+52
1921	654,130,000	−63	3,481,720,000	−33	2,650,000	4,138,500,000	−41
1922	987,180,000	+51	3,656,410,000	+5	3,700,000	4,647,290,000	+12
1923	1,510,930,000	+53	4,471,620,000	+22	3,950,000	5,986,500,000	+29
1924	1,232,330,000	−18	4,067,730,000	−9	5,740,000	5,305,800,000	−11
1925	1,380,280,000	+12	4,291,100,000	+5	6,250,000	5,677,630,000	+7
1926	1,402,920,000	+2	4,803,080,000	+12	7,600,000	6,213,600,000	+9
1927	1,217,700,000	−13	4,304,100,000	−10	8,200,000	5,530,000,000	−11
1928	1,284,580,000	+5	4,091,620,000	−5	9,000,000	5,385,200,000	−3
1929	1,475,990,000	+15	4,400,880,000	+8	10,430,000	5,887,300,000	+9
Grand total	36,398,940,000	--------	77,653,062,000	--------	140,287,000	114,192,289,000	--------

Value of mineral products of the United States, 1925–1929, by States [1]

State	1925	1926	1927	1928	1929
Alabama	$77, 139, 340	$83, 709, 894	$78, 640, 669	$69, 807, 334	$65, 402, 354
Alaska	18, 286, 320	17, 606, 890	14, 402, 440	14, 024, 489	15, 946, 830
Arizona	114, 202, 670	115, 047, 987	100, 558, 556	115, 999, 643	157, 959, 792
Arkansas	87, 185, 532	84, 485, 672	59, 449, 100	45, 009, 780	41, 324, 576
California	496, 923, 376	524, 282, 257	459, 497, 072	434, 261, 175	554, 916, 020
Colorado	63, 512, 998	65, 597, 487	58, 855, 263	58, 594, 688	55, 331, 911
Connecticut	6, 755, 454	7, 695, 341	7, 299, 100	7, 599, 655	7, 053, 468
Delaware	539, 261	375, 945	493, 377	481, 584	467, 493
District of Columbia	954, 795	987, 289	1, 374, 719	1, 031, 216	1, 064, 946
Florida	16, 625, 699	19, 700, 522	18, 095, 961	15, 227, 123	14, 803, 606
Georgia	16, 503, 741	17, 479, 967	16, 758, 390	14, 740, 431	15, 294, 103
Idaho	31, 611, 166	31, 752, 821	29, 183, 929	28, 589, 221	32, 142, 685
Illinois	231, 658, 604	237, 241, 600	180, 393, 779	188, 098, 866	182, 791, 131
Indiana	111, 833, 732	118, 692, 304	107, 578, 234	98, 583, 915	96, 961, 947
Iowa	38, 420, 203	35, 971, 787	33, 426, 375	35, 498, 669	35, 954, 895
Kansas	142, 944, 214	165, 060, 612	120, 368, 526	113, 279, 524	124, 472, 480
Kentucky	131, 370, 840	146, 768, 273	152, 614, 177	131, 969, 907	132, 649, 508
Louisiana	60, 503, 891	62, 203, 543	51, 266, 921	56, 810, 403	62, 725, 997
Maine	5, 838, 718	5, 785, 619	5, 475, 695	5, 922, 729	6, 748, 799
Maryland	21, 557, 810	24, 066, 996	20, 469, 294	18, 417, 781	18, 469, 568
Massachusetts	16, 831, 529	16, 786, 577	16, 295, 373	16, 234, 037	16, 030, 807
Michigan	122, 212, 254	130, 860, 609	124, 029, 572	123, 825, 527	151, 975, 563
Minnesota	110, 252, 956	118, 361, 306	102, 972, 753	108, 274, 963	136, 349, 610
Mississippi	2, 171, 945	1, 882, 986	2, 553, 633	2, 634, 347	2, 572, 616
Missouri	92, 548, 473	90, 003, 537	75, 890, 415	74, 981, 382	78, 948, 484
Montana	79, 261, 284	79, 766, 380	68, 264, 687	74, 752, 309	93, 842, 135
Nebraska	3, 358, 585	3, 322, 460	3, 541, 792	3, 454, 700	4, 844, 542
Nevada	26, 469, 901	27, 613, 232	26, 753, 295	34, 881, 787	36, 776, 293
New Hampshire	3, 464, 837	4, 144, 645	3, 447, 105	3, 816, 065	3, 725, 951
New Jersey	76, 761, 313	77, 065, 713	73, 090, 810	70, 865, 363	71, 891, 861
New Mexico	25, 696, 009	28, 513, 991	28, 608, 776	30, 426, 840	37, 127, 621
New York	102, 035, 557	112, 016, 262	112, 209, 533	108, 025, 720	109, 361, 349
North Carolina	9, 504, 063	10, 992, 793	11, 703, 671	11, 480, 406	10, 963, 896
North Dakota	2, 662, 029	2, 804, 837	2, 869, 663	3, 082, 621	3, 465, 563
Ohio	247, 506, 588	253, 883, 995	226, 962, 529	211, 041, 279	220, 061, 343
Oklahoma	501, 767, 118	569, 518, 693	524, 594, 732	486, 624, 347	516, 685, 232
Oregon	7, 826, 711	6, 941, 355	6, 821, 224	6, 686, 988	6, 876, 703
Pennsylvania	867, 196, 142	1, 055, 766, 077	936, 773, 189	881, 490, 033	892, 913, 833
Rhode Island	1, 151, 857	1, 339, 398	1, 310, 756	830, 742	939, 602
South Carolina	3, 507, 804	3, 677, 209	4, 251, 137	4, 045, 849	3, 592, 112
South Dakota	7, 971, 650	7, 595, 358	8, 463, 952	9, 443, 488	8, 914, 344
Tennessee	38, 869, 198	39, 296, 668	37, 874, 981	39, 216, 757	40, 719, 706
Texas	351, 211, 629	420, 586, 730	374, 503, 420	378, 616, 955	495, 819, 500
Utah	100, 275, 442	98, 985, 218	90, 388, 455	97, 381, 148	115, 130, 581
Vermont	14, 408, 933	14, 955, 161	14, 702, 891	14, 648, 737	14, 602, 589
Virginia	41, 038, 393	46, 136, 458	41, 322, 998	38, 770, 281	39, 752, 683
Washington	22, 382, 132	21, 256, 952	21, 965, 917	22, 119, 541	22, 435, 359
West Virginia	333, 527, 697	395, 941, 940	366, 643, 205	336, 636, 948	346, 564, 746
Wisconsin	19, 205, 380	20, 711, 736	21, 776, 847	20, 938, 179	24, 222, 229
Wyoming	78, 754, 915	78, 988, 066	56, 166, 600	52, 950, 875	51, 237, 407

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[1] In this table iron ore, not pig iron, is taken as the basis of valuation of iron, and in the case of other metals mine production (recoverable content of metals) is the basis.

Mineral products of the United States and principal producing States in 1929

Rank in value	Product	Principal producing States [1]	
		In order of quantity	In order of value
16	Aluminum	New York, Tennessee, North Carolina	Rank same as for quantity.
36	Antimonial lead	Not separable by States	Not separable by States.
58	Arsenious oxide	Montana, Utah, Colorado	Rank same as for quantity.
66	Asbestos	Vermont, Arizona, Georgia, North Carolina	Arizona, Vermont, Georgia, Maryland.
	Asphalt:		
31	Native	Kentucky, Texas, Utah, Oklahoma	Kentucky, Utah, Texas, Oklahoma.
24	Oil	Not separable by States	Not separable by States.
47	Barite (crude)	Missouri, Georgia, Tennessee, California	Rank same as for quantity.
44	Bauxite	Arkansas, Alabama, Georgia	Do.
56	Bismuth	Not separable by States	Not separable by States.
32	Borates	California	Rank same as for quantity.
29	Briquets, fuel	Wisconsin, Pennsylvania, West Virginia, Washington	Wisconsin, Pennsylvania, Oregon, West Virginia.
48	Bromine	Michigan, California, West Virginia, Ohio	Rank same as for quantity.
43	Cadmium (metal and compounds)	Not separable by States	Not separable by States.
46	Calcium-magnesium chloride (natural)	Michigan, California, Ohio, West Virginia	Rank same as for quantity.
8	Cement	Pennsylvania, Michigan, California, Indiana	Pennsylvania, California, Michigan, Indiana.
61	Chats	Missouri, Oklahoma, Kansas	Rank same as for quantity.
83	Chromite	California	Do.
5	Clay products		Ohio, Pennsylvania, New Jersey, Illinois.
25	Clay, raw	Pennsylvania, Missouri, Ohio, California	Pennsylvania, Georgia, Missouri, New Jersey.
1	Coal:		
	Bituminous	Pennsylvania, West Virginia, Illinois, Kentucky	Rank same as for quantity.
	Pennsylvania anthracite	Pennsylvania	Do.
7	Coke	Pennsylvania, Ohio, Indiana, Alabama	Pennsylvania, Indiana, Ohio, Illinois.
81	Columbite	South Dakota	Rank same as for quantity.
6	Copper	Arizona, Utah, Montana, Michigan	Do.
42	Diatomite and tripoli	California, Illinois, Oklahoma, Missouri	California, Oklahoma, Illinois, Missouri.
82	Emery	New York, Virginia	Rank same as for quantity.
51	Feldspar (crude)	North Carolina, New Hampshire, Maine, California	North Carolina, New Hampshire, Maine, New York.
15	Ferro-alloys	Pennsylvania, New York, Ohio, Virginia	Pennsylvania, New York, Virginia, Ohio.
77	Flint lining for tube mills	Minnesota	Rank same as for quantity.
41	Fluorspar	Kentucky, Illinois, Colorado, New Mexico	Do.
33	Fuller's earth	Georgia, Florida, Nevada, Texas	Georgia, Florida, Nevada, Illinois.
63	Garnet, abrasive	New York, New Hampshire	Rank same as for quantity.
(2)	Gems and precious stones	No canvass for 1929	No canvass for 1929.
17	Gold	California, Alaska, South Dakota, Utah	Rank same as for quantity.
68	Graphite		Texas, Alabama, Rhode Island, Michigan.
	Amorphous	Rhode Island, Michigan, Nevada	Rank same as for quantity.
	Crystalline	Texas, Alabama	Do.
54	Grindstones and pulpstones	Ohio, West Virginia, Washington, Michigan	Do.

[1] Rank of States in metal production (except aluminum, ferro-alloys, and pig iron) arranged according to mine reports, not smelter output.

[2] No canvass for 1929.

Mineral products of the United States and principal producing States in 1929—Continued

Rank in value	Product	Principal producing States	
		In order of quantity	In order of value
21	Gypsum	New York, Michigan, Iowa, Texas	New York, Iowa, Michigan, Texas.
10	Iron ore	Minnesota, Michigan, Alabama, Wisconsin	Rank same as for quantity.
3	Iron, pig	Pennsylvania, Ohio, Illinois, Indiana	Do.
13	Lead	Missouri, Utah, Idaho, Oklahoma	Do.
19	Lime	Ohio, Pennsylvania, Missouri, West Virginia	Do.
75	Lithium minerals	New Mexico, South Dakota	Do.
50	Magnesite	Washington, California	Do.
62	Magnesium	Michigan	Do.
55	Magnesium salts (natural)	Michigan, California	Do.
49	Manganese ore	Montana, Arkansas, Virginia, New Mexico	Montana, Arkansas, Virginia, Georgia.
35	Manganiferous ore	Minnesota, New Mexico, Michigan, Colorado	Minnesota, New Mexico, Michigan, Arkansas.
65	Manganiferous zinc residuum	New Jersey	Rank same as for quantity.
	Marl:		
73	Calcareous	California, West Virginia, Virginia, South Carolina	Do.
70	Greensand	New Jersey, Texas	Do.
40	Mercury	California, Nevada, Oregon, Texas	Do.
64	Mica	North Carolina, New Hampshire, Virginia, New Mexico	North Carolina, New Hampshire, Connecticut, Virginia.
	Scrap	do	Rank same as for quantity.
	Sheet	New Hampshire, North Carolina, Connecticut, Virginia	North Carolina, New Hampshire, Connecticut, Virginia.
74	Micaceous minerals	North Carolina, Georgia, California, Montana	North Carolina, Georgia, Montana, California.
79	Millstones		New York, North Carolina, Virginia.
23	Mineral paints, zinc and lead pigments	Pennsylvania, Ohio, Indiana, Illinois	Rank same as for quantity.
([2])	Mineral waters	No canvass for 1929	No canvass for 1929.
45	Molybdenum	Colorado, New Mexico, Arizona	Rank same as for quantity.
4	Natural gas	Texas, Oklahoma, California, Louisiana	West Virginia, California, Texas, Oklahoma.
11	Natural gasoline	California, Oklahoma, Texas, West Virginia	Rank same as for quantity.
69	Nickel	Not separable by States	Not separable by States.
71	Oilstones, etc	Ohio, Vermont, Arkansas, Indiana	Arkansas, Ohio, Vermont, Indiana.
([2])	Peat	No canvass for 1929	No canvass for 1929.
80	Pebbles for grinding	Minnesota, California	Rank same as for quantity.
2	Petroleum	Texas, California, Oklahoma, Kansas	Oklahoma, Texas, California, Kansas.
26	Phosphate rock	Florida, Tennessee, Idaho, Wyoming	Rank same as for quantity.
37	Platinum and allied metals	Alaska, California, Oregon	Do.
38	Potassium salts	California, Maryland, Utah, Indiana	Do.
67	Pumice	Kansas, Nebraska, California, Oregon	Do.
53	Pyrites	Tennessee, Virginia, California, Wisconsin	Tennessee, California, Virginia, Wisconsin.
22	Salt	Michigan, New York, Ohio, Kansas	Michigan, New York, Kansas, Ohio.
12	Sand and gravel	New York, Illinois, Michigan, California	New York, Pennsylvania, Ohio, Illinois.
39	Sand-lime brick	Michigan, New York, New Jersey, Massachusetts	Michigan, Massachusetts, New Jersey, New York.
60	Selenium	Not separable by States	Not separable by States.

72	Silica (quartz)	California, Wisconsin, Maryland, North Carolina	Wisconsin, California, North Carolina, Massachusetts.
52	Silica sand and sandstone (finely ground)	Illinois, West Virginia, Pennsylvania, New Jersey	West Virginia, Pennsylvania, Illinois, New Jersey.
20	Silver	Utah, Montana, Idaho, Arizona	Rank same as for quantity.
27	Slate		Pennsylvania, Vermont, New York, Virginia.
30	Sodium salts (other than NaCl) from natural sources.	California, Wyoming, Nevada, Washington	Rank same as for quantity.
9	Stone	Pennsylvania, Ohio, Michigan, New York	Indiana, Pennsylvania, New York, Ohio.
18	Sulphur	Texas, Utah, Nevada	Texas, Nevada, Utah.
28	Sulphuric acid from copper and zinc smelters.	Tennessee, Illinois, Pennsylvania, Arizona	Tennessee, Illinois, Pennsylvania, Ohio.
34	Talc and soapstone	New York, Vermont, Virginia, California	New York, Virginia, Vermont, California.
84	Tellurium	Not separable by States	Not separable by States.
78	Tin	Alaska, California, South Dakota	Rank same as for quantity.
	Titanium ore:		
85	Ilmenite	Virginia	Do.
76	Rutile	do	Do.
59	Tungsten ore	Nevada, Colorado, California, Arizona	Do.
57	Uranium and vanadium ores	Colorado, Arizona, Utah	Colorado, Utah, Arizona.
14	Zinc	Oklahoma, Kansas, New Jersey, Montana	Oklahoma, New Jersey, Kansas, Montana.

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[3] No canvass for 1929.

States and their principal mineral products in 1929 [1]

State	Rank	Percentage of total value for United States	Principal mineral products in order of value
Alabama	19	1.26	Coal, iron ore, cement, clay products.
Alaska	34	.31	Gold, copper, coal, silver.
Arizona	8	3.05	Copper, gold, silver, lead.
Arkansas	23	.80	Petroleum, coal, natural gas, natural gasoline.
California	2	10.71	Petroleum, natural gas, natural gasoline, cement.
Colorado	21	1.07	Coal, gold, zinc, clay products.
Connecticut	40	.14	Stone, clay products, sand and gravel, lime.
Delaware	50	.01	Clay products, stone, sand and gravel.
District of Columbia	48	.02	Sand and gravel, clay products, sand-lime brick, stone.
Florida	36	.29	Phosphate rock, stone, fuller's earth, cement.
Georgia	35	.30	Stone, clay products, fuller's earth, cement.
Idaho	29	.62	Lead, zinc, silver, copper.
Illinois	7	3.53	Coal, clay products, cement, petroleum.
Indiana	15	1.87	Coal, stone, clay products, cement.
Iowa	28	.69	Coal, cement, clay products, gypsum.
Kansas	12	2.40	Petroleum, zinc, natural gas, cement.
Kentucky	11	2.56	Coal, petroleum, natural gas, clay products.
Louisiana	20	1.21	Natural gas, petroleum, natural gasoline, salt.
Maine	42	.13	Stone, cement, lime, slate.
Maryland	32	.36	Clay products, coal, cement, sand and gravel.
Massachusetts	33	.31	Stone, sand and gravel, clay products, lime.
Michigan	9	2.93	Iron ore, copper, cement, stone.
Minnesota	10	2.63	Iron ore, stone, cement, manganiferous ore.
Mississippi	47	.05	Sand and gravel, clay products, stone, natural gas.
Missouri	17	1.52	Lead, clay products, cement, coal.
Montana	16	1.81	Copper, zinc, coal, petroleum.
Nebraska	43	.09	Sand and gravel, cement, clay products, stone.
Nevada	27	.71	Copper, gold, silver, gypsum.
New Hampshire	44	.07	Sand and gravel, stone, clay products, feldspar.
New Jersey	18	1.39	Clay products, zinc, sand and gravel, cement.
New Mexico	26	.72	Copper, coal, zinc, petroleum.
New York	14	2.11	Stone, clay products, cement, sand and gravel.
North Carolina	38	.21	Stone, clay products, copper, sand and gravel.
North Dakota	46	.07	Coal, clay products, sand and gravel, natural gas.
Ohio	6	4.25	Clay products, coal, natural gas, petroleum.
Oklahoma	3	9.97	Petroleum, natural gas, natural gasoline, zinc.
Oregon	41	.13	Stone, cement, sand and gravel, clay products.
Pennsylvania	1	17.23	Coal, cement, clay products, natural gas.
Rhode Island	49	.02	Stone, sand and gravel, clay products, graphite.
South Carolina	45	.07	Stone, clay products, sand and gravel, barite.
South Dakota	39	.17	Gold, cement, stone, sand and gravel.
Tennessee	24	.79	Coal, stone, cement, clay products.
Texas	4	9.57	Petroleum, natural gas, sulphur, natural gasoline.
Utah	13	2.22	Copper, lead, coal, silver.
Vermont	37	.28	Stone, slate, talc, lime.
Virginia	25	.77	Coal, stone, clay products, zinc.
Washington	31	.43	Coal, cement, clay products, sand and gravel.
West Virginia	5	6.69	Coal, natural gas, clay products, petroleum.
Wisconsin	30	.47	Stone, iron ore, sand and gravel, clay products.
Wyoming	22	.99	Petroleum, coal, natural gas, natural gasoline.

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[1] In this table iron ore, not pig iron, is taken as the basis of iron valuation, and in the case of other metals mine production (recoverable content of metals) is the basis.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver [1]	Copper [2]	Lead [2]	Zinc [2]	Year	Silver [1]	Copper [2]	Lead [2]	Zinc [2]
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1920	$1.09	$0.184	$0.080	$0.081	1925	$0.694	$0.142	$0.087	$0.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064
1923	.82	.147	.070	.068	1928	.585	.144	.058	.061
1924	.67	.131	.080	.065	1929	.533	.176	.063	.066

[1] Average price furnished by Bureau of the Mint.

[2] Average price, all grades.

DETAILED TABLES

ABRASIVE MATERIALS

Natural abrasives sold by producers in the United States, 1920–1929 [1]

Year	Millstones [2]	Grindstones		Pulpstones [3]		Oilstones and scythestones		Emery	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1920	$63,325	44,832	$1,239,990	8,652	$467,014	1,144	$231,747	2,327	$21,685
1921	24,524	16,310	477,259	10,030	750,063	831	173,025	305	2,250
1922	20,853	21,367	574,900	6,157	445,286	1,016	197,450	1,468	17,511
1923	22,229	37,384	1,008,899	9,186	680,416	1,223	231,812	2,286	29,478
1924	30,125	28,991	852,260	9,193	814,409	1,056	258,943	2,195	19,756
1925	22,490	28,970	864,637	8,370	841,302	970	272,224	769	5,907
1926	45,937	28,669	875,240	9,670	997,994	1,680	223,359	386	3,641
1927	35,438	23,222	633,207	8,709	921,543	1,048	233,545	506	5,855
1928	42,886	24,222	606,408	9,016	902,429	956	228,245	1,341	16,787
1929	31,407	21,071	617,618	6,665	623,928	838	212,017	924	10,722

Year	Garnet		Diatomite		Tripoli (including rottenstone)			Pumice and pumicite		Grinding pebbles and tube-mill lining	
						Value					
	Short tons	Value	Short tons	Value	Short tons	Crude (estimated)	As sold (crude and finished)	Short tons	Value	Short tons	Value
1920	5,476	$434,425	61,922	$1,079,693	40,233	$164,076	$569,677	41,838	$114,433	10,924	$77,823
1921	3,048	260,687	[4] 55,134	[4] 682,616	12,340	53,892	213,013	37,108	158,540	989	14,637
1922	7,054	566,879	44,761	386,669	30,205	105,309	316,728	45,262	175,600	3,159	30,798
1923	9,006	688,437	65,833	699,406	27,082	62,190	382,757	56,575	214,169	4,551	51,795
1924	8,290	674,176	63,163	693,917	28,476	55,537	389,409	43,651	190,253	2,532	37,429
1925	8,429	712,853	73,030	922,281	29,388	58,770	434,886	40,380	179,020	3,831	50,147
1926	6,397	523,875	[4] 87,126	[4] 1,081,564	31,369	65,022	523,609	53,887	208,504	6,219	85,146
1927	6,939	573,525	(5)	(5)	26,099	66,452	447,068	53,298	221,481	3,342	46,856
1928	6,617	459,307	(5)	(5)	34,043	73,689	555,576	57,430	278,516	6,288	89,321
1929	5,961	435,420	(5)	(5)	38,011	74,475	545,658	60,873	318,579	4,630	66,178

[1] For figures on abrasive feldspar and quartz, see sections on feldspar and silica.
[2] Figures for quantity not available.
[3] Exclusive of sales in Washington prior to 1923.
[4] Partly estimated.
[5] Bureau of Mines not at liberty to publish figures.

Value of abrasive materials imported for consumption in the United States, 1920–1929

Material	1920	1921	1922	1923	1924
Millstones and burrstones	$20,954	$13,556	$15,356	$20,102	$6,311
Grindstones	77,046	81,880	81,733	106,028	122,440
Hones, oilstones, and whetstones	56,416	35,761	48,938	53,233	43,579
Emery and corundum	617,187	393,454	389,390	722,688	364,755
Garnet	(1)	(1)	[1] 1,837	93,803	54,402
Diatomaceous earth, tripoli, and rottenstone	16,323	13,203	10,429	11,779	9,504
Pumice	249,995	173,201	118,458	128,693	111,284
Diamond:					
Dust and bort	3,387,488	466,345	1,029,261	228,409	259,482
Glaziers' and engravers', unset, and miners'	1,527,753	435,872	839,882	1,065,834	1,116,862
Flint, flints, and flint stones, unground	338,630	116,157	145,805	130,974	114,958

Material	1925	1926	1927	1928	1929
Millstones and burrstones	$8,413	$6,266	$12,726	$6,354	$6,564
Grindstones	124,319	120,335	134,804	114,874	119,264
Hones, oilstones, and whetstones	49,108	63,152	67,368	45,303	48,207
Emery and corundum	313,718	616,700	264,613	272,533	494,174
Garnet	200	----------	----------	115	----------
Diatomaceous earth, tripoli, and rottenstone	6,589	14,544	15,403	21,883	23,183
Pumice	130,460	129,449	124,074	159,430	143,944
Diamond:					
Dust and bort	760,476	271,382	62,045	31,222	89,363
Glaziers' and engravers', unset, and miners'	1,976,640	1,939,735	2,148,275	2,756,895	4,067,674
Flint, flints, and flint stones, unground	105,041	120,078	93,658	144,313	127,457

[1] Not separately classified prior to change in tariff, Sept. 22, 1922.

Value of domestic abrasive materials exported, 1920–1929

Material	1920	1921	1922	1923	1924
Grindstones	$424,322	$281,976	$281,413	$499,123	$481,397
Abrasive wheels, emery, and other	2,791,128	1,318,804	644,151	571,733	521,840
All other natural abrasives, hones, whetstones, etc	3,810,171	1,719,810	292,051	342,737	173,731

Material	1925	1926	1927	1928	1929
Grindstones	$553,750	$629,748	$578,113	$560,975	$391,239
Abrasive wheels, emery, and other	439,904	248,631	240,027	254,493	286,360
All other natural abrasives, hones, whetstones, etc	195,915	323,447	419,088	453,055	423,363

ALUMINUM

[See Bauxite and aluminum]

ANTIMONY AND ANTIMONIAL LEAD

Mine production of antimony ores in the United States, 1920–1929, in short tons

Year	Ore	Antimony content	Year	Ore	Antimony content
1920–1921			1926	99	43
1922	20	4	1927		
1923	40	10	1928	86	42
1924	113	33	1929		
1925	123	33			

Only two smelters reported production of metallic antimony in the United States in 1926 and 1927 and only one in 1920, 1925, and 1928; the Bureau of Mines is not at liberty to publish the figures. No production was reported for 1921 to 1924 and for 1929. The total output in 1928 and part of that in 1926 came from domestic ore smelted.

Secondary antimony and antimony content of secondary alloys recovered from old alloys, scrap, and dross in the United States, 1920–1929

Year	Short tons	Value [1]	Year	Short tons	Value [1]
1920	5,600	$938,560	1925	10,840	$3,794,000
1921	4,720	464,400	1926	16,230	5,164,400
1922	7,090	765,700	1927	12,400	3,060,300
1923	8,021	1,252,800	1928	11,900	2,451,400
1924	9,404	2,025,600	1929	11,131	1,990,200

[1] Values calculated at average yearly price for ordinary brands of antimony as published by the American Metal Market.

By-product antimonial lead produced in the United States from both foreign and domestic ores, 1920–1929

Year	Short tons	Value	Antimony content (short tons)	Year	Short tons	Value	Antimony content (short tons)
1920	12,535	$1,963,255	2,033	1925	19,667	$3,785,547	2,624
1921	10,064	870,059	1,589	1926	22,524	3,916,714	2,693
1922	8,075	844,993	1,441	1927	24,347	3,277,043	2,736
1923	14,190	1,950,370	2,170	1928	33,058	3,978,318	3,432
1924	20,787	3,376,713	2,763	1929	25,669	3,267,095	3,052

Antimony imported for consumption in the United States, 1920–1929

Year	Antimony ore [1]			Liquated antimony sulphide [2]		Metallic antimony [3]		Antimony oxides and other compounds [4]	
	Short tons	Antimony content		Short tons	Value	Short tons	Value	Short tons	Value
		Short tons	Value						
1920	1,709	682	$70,285	1,375	$123,902	9,817	$1,216,376	298	$25,260
1921	213	98	11,682	353	17,577	10,130	784,146	154	15,558
1922	------	------	------	689	40,108	9,344	659,242	379	65,538
1923	([5])	1,047	44,721	835	64,493	6,763	641,804	2,277	288,206
1924	([5])	899	62,999	558	52,393	6,778	840,434	1,207	190,252
1925	1,359	773	47,084	760	115,990	9,857	2,362,915	1,792	349,990
1926	2,497	1,559	287,258	2,040	343,705	11,506	3,144,330	2,259	517,584
1927	3,566	2,015	282,098	1,077	134,949	9,891	2,111,411	1,803	484,873
1928	3,912	2,185	313,127	1,208	158,231	9,684	1,641,265	2,643	448,156
1929	3,161	1,865	231,086	1,803	174,104	11,073	1,622,182	2,222	359,247

[1] Classified in tariff classification as "Antimony ore and stibnite containing antimony."

[2] Classified in tariff classification as "Antimony matte, containing not more than 10 per cent of lead"; also as "needle or liquated antimony."

[3] Classified in tariff classification as "Antimony regulus or metal."

[4] Classified in tariff classification as "Antimony, oxide, salts, and compounds of."

[5] Figures not available.

Foreign antimony (matte, regulus, or metal) exported from the United States, 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	896,034	$51,607	1925	188,976	$17,376
1921	299,776	15,741	1926	367,942	41,554
1922 [1]	37,218	1,548	1927	726,694	72,280
1923	15,958	1,047	1928	1,198,339	90,975
1924	279,920	14,441	1929	1,017,656	71,415

[1] During 1922 exports of "matte, regulus, or metal" of domestic manufacture were 224,610 pounds, valued at $13,961. This is the first export of domestic antimony of which there is any record. However, antimony manufactured in the United States from foreign ores and exported would be classed as domestic exports. Similar exports for 1923 to 1929 are not shown.

ARSENIC

White arsenic (refined and crude) sold by producers in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	11,502	$2,021,356	1925	12,317	$1,199,247
1921	4,786	717,700	1926	11,805	674,350
1922	10,027	1,475,229	1927	11,560	725,360
1923	14,271	2,808,801	1928	11,767	735,373
1924	14,453	2,655,015	1929	14,546	883,771

Arsenic compounds and metallic arsenic imported for consumption in the United States, 1920–1929

Year	Arsenious acid (white arsenic, As_2O_3)		Arsenic sulphide (realgar and orpiment)		Sheep dip		Paris green and London purple	
	Short tons	Value	Short tons	Value	Pounds	Value	Pounds	Value
1920	3, 740	$532, 635	4, 080	$684, 016	70, 168	$5, 150	772	$277
1921	1, 669	253, 250	3, 343	531, 322	61, 377	6, 362	325	123
1922	1, 081	162, 494	3, 815	472, 044	70, 390	4, 877	3, 866	741
1923	10, 152	1, 985, 400	1, 097	268, 311	87, 739	5, 237	100, 781	20, 586
1924	8, 877	1, 597, 433	234	45, 246	114, 801	10, 764	76, 241	15, 683
1925	9, 316	1, 076, 073	476	63, 296	73, 477	4, 953	2, 880	702
1926	7, 703	510, 227	283	40, 718	119, 947	14, 070	4, 747	1, 011
1927	12, 517	921, 998	206	35, 089	102, 394	8, 952	---------	---------
1928	11, 153	775, 169	263	51, 278	175, 055	17, 592	13, 279	1, 497
1929	13, 157	956, 176	212	40, 976	208, 770	21, 533	1, 102	200

Year	Arsenic acid (H_3AsO_4)		Calcium arsenate		Lead arsenate		Metallic arsenic	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1920–1921	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
1922 [2]	41, 296	$4, 195	---------	---------	---------	---------	22, 487	$3, 484
1923	166, 354	15, 597	---------	---------	26	$9	174, 415	37, 314
1924	420	121	3, 172	$278	3, 585	525	122, 467	23, 684
1925	59, 112	2, 676	1, 074	135	10, 467	1, 514	149, 018	31, 918
1926	2, 340	165	1, 057	284	---------	---------	174, 490	35, 745
1927	11, 685	470	3, 807	717	---------	---------	245, 686	47, 875
1928	75	30	1, 323	233	---------	---------	186, 622	35, 584
1929	247	26	---------	---------	200	26	287, 545	50, 730

[1] Figures not available.
[2] Figures cover period Sept. 22 to Dec. 31. Not separately classified prior to change in tariff.

Exports of domestic arsenic were not separately recorded by the Bureau of Foreign and Domestic Commerce prior to 1928, when they were as follows: Calcium arsenate, 1,178,702 pounds, valued at $67,151; lead arsenate, 1,093,673 pounds, $141,235. Similar exports in 1929 were as follows: Calcium arsenate, 3,139,633 pounds, $171,123; lead arsenate, 1,563,982 pounds, $192,185.

ASBESTOS

Asbestos sold by producers in the United States, 1920–1929, by varieties

Year	Chrysotile		Amphibole		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	1, 245	$661, 907	403	$16, 324	1, 648	$678, 231
1921	438	313, 268	393	23, 700	831	336, 968
1922	25	3, 320	42	6, 800	67	10, 120
1923	69	4, 433	158	5, 193	227	9, 626
1924	173	33, 941	127	8, 585	300	42, 526
1925	93	40, 750	1, 165	10, 950	1, 258	51, 700
1926	(1)	(1)	(1)	(1)	1, 358	134, 731
1927	(1)	(1)	(1)	(1)	2, 981	336, 882
1928	(1)	(1)	(1)	(1)	2, 239	351, 178
1929	1, 983	317, 584	1, 172	33, 420	3, 155	351, 004

[1] **Bureau of Mines not at liberty to publish figures.**

Asbestos (unmanufactured) imported into and exported from the United States, 1920–1929

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1920	167, 558	$9, 120, 253	615	$141, 071
1921	72, 463	2, 948, 302	520	101, 600
1922	149, 427	5, 144, 700	376	49, 939
1923	212, 420	7, 445, 143	680	48, 525
1924	183, 250	5, 602, 945	1, 270	93, 163
1925	230, 520	7, 134, 302	1, 109	70, 846
1926	257, 621	8, 142, 505	1, 104	85, 922
1927	223, 693	8, 150, 340	309	48, 774
1928	230, 595	9, 017, 891	850	346, 632
1929	262, 427	11, 153, 017	709	108, 467

ASPHALT AND RELATED BITUMENS

Native asphalt and related bitumens sold at mines in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	198, 497	$1, 213, 908	1925	584, 850	$4, 148, 400
1921	296, 412	1, 985, 583	1926	715, 180	4, 484, 960
1922	327, 792	2, 253, 180	1927	839, 040	5, 605, 850
1923	400, 236	2, 885, 631	1928	807, 860	5, 175, 055
1924	562, 367	3, 958, 339	1929	804, 027	5, 470, 493

Asphalt, manufactured in the United States from petroleum, sold at refineries in 1920–1929

Year	From domestic petroleum		From foreign petroleum	
	Short tons	Value	Short tons	Value
1920	700, 496	$11, 985, 457	1, 045, 779	$14, 272, 862
1921	624, 220	9, 048, 221	908, 093	11, 761, 358
1922	805, 145	10, 385, 925	1, 242, 163	13, 899, 407
1923	995, 654	13, 060, 174	1, 378, 722	16, 840, 045
1924	1, 158, 456	14, 305, 007	1, 920, 915	21, 710, 793
1925	1, 206, 700	15, 305, 760	1, 971, 670	27, 520, 010
1926	1, 245, 160	15, 452, 940	2, 213, 310	31, 098, 460
1927	1, 525, 420	19, 019, 150	2, 426, 030	35, 771, 940
1928	1, 930, 536	22, 060, 312	2, 298, 848	30, 056, 866
1929	2, 332, 973	24, 135, 787	2, 355, 498	27, 057, 868

Asphalt and related bitumens imported for consumption in the United States, 1920–1929

Year	Crude asphalt		Ozokerite	
	Short tons	Value	Short tons	Value
1920	127, 027	$1, 055, 951	2, 136	$499, 758
1921	116, 450	972, 166	4, 274	546, 054
1922	120, 359	940, 873	4, 495	371, 161
1923	138, 430	1, 046, 603	2, 428	213, 407
1924	156, 662	1, 165, 253	1, 557	207, 833
1925	113, 384	823, 165	3, 088	361, 767
1926	140, 746	1, 025, 629	4, 144	479, 957
1927	157, 982	1, 138, 898	3, 800	579, 118
1928	119, 560	864, 607	5, 451	594, 416
1929	121, 019	955, 606	4, 896	616, 617

Asphalt and related bitumens imported for consumption in the United States, 1920–1929—Continued

Year	Ichthyol		Bituminous limestone		Total	
	Pounds	Value	Short tons	Value	Short tons	Value
1920	98,135	$79,133	1,387	$11,665	130,599	$1,646,507
1921	76,020	107,752	12,085	157,124	132,847	1,783,096
1922	74,330	89,150	4,300	59,590	129,191	1,460,774
1923	[1] 20	15	6,205	33,303	147,063	1,293,328
1924	9,300	17,058	3,354	37,906	161,578	1,428,050
1925	560	1,281	8,778	84,259	125,250	1,270,472
1926	25,396	34,385	1,886	19,967	146,789	1,559,938
1927	48,199	58,821	118	1,500	161,924	1,778,337
1928	42,610	60,321	28	439	125,060	1,519,783
1929	32,529	42,066	----------	----------	125,931	1,614,289

[1] As recorded by Bureau of Foreign and Domestic Commerce. Reclassification after change in tariff, Sept. 22, 1922, may account to some extent for great decrease.

Native asphalt and related bitumens exported from the United States, 1920–1929

Year	Unmanufactured		Manufactures of (value)	Total value
	Short tons	Value		
1920	51,706	$1,356,116	$842,074	$2,198,190
1921	45,367	1,178,038	621,224	1,799,262
1922	57,362	1,344,440	[1] 1,261,125	2,605,565
1923	72,628	1,500,869	[1] 2,075,628	3,576,497
1924	52,568	1,245,670	[1] 2,212,260	3,457,930
1925	32,835	825,654	[1] 2,525,618	3,351,272
1926	38,218	905,743	[1] 2,189,808	3,095,551
1927	39,875	1,034,334	[1] 2,399,700	3,434,034
1928	26,263	683,563	[1] 2,022,251	2,705,814
1929	46,962	1,133,058	[1] 2,382,260	3,515,318

[1] Includes value of squares (10 by 10 feet) of roofing asphalt as follows: 1922, 588,636 squares, $870,200; 1923, 783,028 squares, $1,124,491; 1924, 697,293 squares, $998,469; 1925, 661,662 squares, $919,977; 1926, 938,176 squares, $1,212,409; 1927, 853,842 squares, $1,150,722; 1928, 934,908 squares, $1,251,429; 1929, 829,066 squares, $1,102,192. Corresponding exports not separately shown prior to 1922.

Exports of petroleum asphalt were not separately recorded until 1925, when 89,014 short tons, valued at $1,762,048, was exported. Similar exports in 1926 were 146,589 tons, $3,183,746; in 1927, 385,031 tons, $8,325,413; in 1928, 492,362 tons, $9,788,501; and in 1929, 479,404 tons, $8,542,975.

BARITE AND BARIUM PRODUCTS

BARITE

Crude barite sold or used by producers in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	228,113	$2,142,464	1925	228,063	$1,703,097
1921	66,369	531,958	1926	237,875	1,773,293
1922	155.040	1,123,950	1927	254,265	1,670,878
1923	214,183	1,664,156	1928	269,544	1,754,924
1924	196,332	1,540,744	1929	277,269	1,850,706

Crude barite sold or used by producers in the United States, 1928 and 1929, by States

State	1928		1929	
	Short tons	Value	Short tons	Value
California	12,557	$51,502	24,701	$147,762
Colorado	40	340		
Georgia	112,316	675,509	94,118	546,212
Missouri	114,274	810,203	118,679	880,319
Nevada			818	6,384
Tennessee	20,260	150,937	26,140	181,725
Other States [1]	10,097	66,433	12,813	88,304
	269,544	1,754,924	277,269	1,850,706

[1] South Carolina, Virginia, and Wisconsin.

Crude domestic and foreign barite used in the manufacture of barium products in the United States, 1920–1929, in short tons

Year	In manufacture of—		
	Ground barite	Lithopone	Barium chemicals
1920	79,052	113,181	37,210
1921	28,296	61,359	10,952
1922	48,280	94,259	25,303
1923	47,713	128,547	34,327
1924	42,855	137,127	33,181
1925	56,851	146,693	29,141
1926	69,048	178,889	33,119
1927	73,119	222,791	34,280
1928	74,814	211,592	48,289
1929	58,770	223,188	52,448

Crude barite imported for consumption in the United States, 1920–1929

Year	Short tons	Value
1920	24,874	$146,858
1921	11,054	59,371
1922	23,239	104,680
1923	15,045	93,721
1924	21,502	104,264
1925	28,655	$91,016
1926	51,016	195,004
1927	70,274	253,284
1928	61,765	190,756
1929	85,729	284,436

Exports of barite are not separately reported.

BARIUM PRODUCTS

Barium products, manufactured in the United States from either domestic or imported crude ore, sold or used by producers in 1920–1929, in short tons [1]

Product	1920	1921	1922	1923	1924
Ground barite	65,748	27,661	46,176	39,605	38,296
Lithopone	89,373	55,016	83,360	98,199	109,469
Barium chemicals:					
Binoxide	(2)	----------	(2)	----------	----------
Carbonate	7,484	1,956	2,281	6,362	6,058
Chloride	3,084	(2)	2,022	3,301	3,859
Nitrate	(2)	----------	----------	----------	----------
Sulphate (blanc fixe)	8,046	2,471	7,349	6,761	7,796
Other [3]	2,146	1,060	2,249	379	441
	175,881	88,164	143,437	154,607	165,919

Product	1925	1926	1927	1928	1929
Ground barite	49,674	57,812	57,658	64,425	54,472
Lithopone	145,019	159,931	176,994	200,468	206,315
Barium chemicals:					
Carbonate	4,962	5,394	5,969	7,626	7,902
Chloride	(2)	4,592	3,708	5,224	6,545
Sulphate (blanc fixe)	11,748	(2)	13,395	(2)	(2)
Other [3]	1,944	11,925	871	21,119	23,991
	213,347	239,654	258,595	298,862	299,225

[1] In order to avoid duplication of figures, barium chemicals manufactured from other barium chemicals bought in open market are not included in table.

[2] Included under "Other."

[3] Figures cover chemicals, as follows—1920: Binoxide, hydroxide, nitrate, and sulphide; 1921 and 1925: Chloride, hydroxide, and sulphide; 1922: Binoxide, hydroxide, sulphide, and sulphydrate; 1923–24: Hydroxide and sulphide; 1926: Hydroxide, sulphate, and sulphide; 1927: Binoxide, hydroxide, and sulphide; 1928–29: Binoxide, hydroxide, sulphate, and sulphide.

Barium products imported for consumption in the United States, 1920–1929

Product	1920	1921	1922	1923	1924
Manufactured barite	$3,017	$16,942	$59,453	$88,741	$38,292
Lithopone	263,240	432,019	885,671	776,383	543,025
Barium carbonate:					
Natural (ground witherite)	61,284	25,188	39,114	41,823	56,415
Manufactured (chemically precipitated)	37,462	80,603	210,250	79,482	128,217
Barium binoxide	64,447	127,631	189,334	152,270	120,374
Barium chloride	151,778	72,621	112,785	75,014	100,810
Blanc fixe, or barium sulphate (chemically precipitated)	8,485	22,470	76,445	32,063	50,465
Barium hydroxide	(1)	(1)	[1] 6,573	16,872	8,241
Barium nitrate	(1)	(1)	[1] 16,795	59,766	54,638
	589,713	777,474	1,596,420	1,322,414	1,100,477

Product	1925	1926	1927	1928	1929	
					Short tons	Value
Manufactured barite	$40,008	$44,781	$38,568	$33,378	2,924	$34,619
Lithopone	478,395	661,700	656,166	808,200	8,409	725,554
Barium carbonate:						
Natural (ground witherite)	63,634	80,679	65,821	82,434	4,376	99,335
Manufactured (chemically precipitated)	160,164	189,167	119,014	116,241	3,206	69,236
Barium binoxide	70,553	8,157	1,264	1,310	(2)	21
Barium chloride	67,306	49,426	45,285	25,253	78	3,049
Blanc fixe, or barium sulphate (chemically precipitated)	81,439	136,697	107,179	168,923	3,501	168,367
Barium hydroxide	5,605	9,789	12,439	10,031	202	11,809
Barium nitrate	58,192	49,494	65,284	69,010	615	56,770
	1,025,296	1,229,890	1,111,020	1,314,780	23,311	1,168,760

[1] Not separately classified prior to change in tariff, Sept. 22, 1922.

[2] 133 pounds.

Prior to 1922 barium products had not been exported in appreciable quantity, and no separate record of the exports was kept. Exports of lithopone have been as follows: 1922, 1,616 short tons, valued at $169,982; 1923, 1,485 tons, $176,624; 1924, 923 tons, $104,783; 1925, 1,287 tons, $132,771; 1926, 1,941 tons, $200,412; 1927, 2,110 tons, $222,585; 1928, 3,326 tons, $337,565; and 1929, 4,556 tons, $463,235.

BAUXITE AND ALUMINUM

BAUXITE

Bauxite produced in the United States, 1920–1929

Year	Georgia, Alabama, and Tennessee		Arkansas		Total	
	Long tons	Value	Long tons	Value	Long tons	Value
1920	40, 029	$349, 453	481, 279	$2, 897, 892	521, 308	$3, 247, 345
1921	14, 700	134, 400	124, 850	755, 400	139, 550	889, 800
1922	42, 810	329, 440	266, 790	1, 682, 890	309, 600	2, 012, 330
1923	28, 810	176, 030	493, 880	2, 980, 580	522, 690	3, 156, 610
1924	19, 940	156, 990	327, 630	1, 981, 000	347, 570	2, 137, 990
1925	20, 220	109, 800	296, 320	1, 878, 450	316, 540	1, 988, 250
1926	20, 680	116, 650	371, 570	2, 298, 550	392, 250	2, 415, 200
1927	17, 110	95, 920	303, 830	1, 892, 860	320, 940	1, 988, 780
1928	14, 190	80, 668	361, 236	2, 193, 230	375, 426	2, 273, 898
1929	14, 723	84, 480	351, 054	2, 181, 158	365, 777	2, 265, 638

Bauxite imported into and exported from the United States, 1920–1929

Year	Imports for consumption		Exports (including bauxite concentrates)	
	Long tons	Value	Long tons	Value
1920	42, 895	$251, 284	22, 257	$1, 843, 596
1921	27, 587	164, 589	5, 942	488, 785
1922	23, 656	93, 805	19, 617	961, 208
1923	119, 020	593, 882	78, 560	3, 380, 486
1924	201, 974	909, 493	77, 065	3, 979, 832
1925	353, 696	1, 549, 120	78, 633	4, 134, 455
1926	281, 644	1, 187, 497	87, 770	4, 741, 260
1927	356, 580	1, 572, 236	121, 858	7, 800, 491
1928	350, 111	1, 534, 498	112, 984	5, 210, 912
1929	380, 812	1, 753, 840	133, 551	3, 926, 283

ALUMINUM

Aluminum produced in the United States, 1920–1929

Year	Primary metal		Secondary metal [1]	
	Pounds	Value	Pounds	Value
1920	138, 000, 000	$41, 375, 000	31, 000, 000	$9, 489, 100
1921	55, 000, 000	10, 906, 000	17, 800, 000	3, 775, 400
1922	74, 000, 000	13, 622, 000	32, 580, 000	6, 085, 900
1923	129, 000, 000	28, 305, 000	42, 600, 000	10, 824, 600
1924	150, 000, 000	37, 607, 000	54, 000, 000	14, 596, 200
1925	140, 000, 000	36, 430, 000	88, 000, 000	24, 816, 000
1926	145, 000, 000	37, 583, 000	88, 400, 000	23, 868, 000
1927	160, 000, 000	39, 266, 000	92, 400, 000	23, 469, 600
1928	210, 000, 000	47, 899, 000	95, 600, 000	22, 848, 400
1929	225, 000, 000	51, 864, 000	96, 800, 000	23, 135, 200

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[1] Value of secondary aluminum based on average price at New York, as given by American Metal Market.

Aluminum imported for consumption in the United States, 1920–1929

Year	Crude and semicrude [1]		Manufactures of [2]	Total value
	Pounds	Value		
1920	39,298,649	$12,183,891	$893,131	$13,077,022
1921	32,559,017	7,627,508	1,262,283	8,889,791
1922	43,891,933	8,286,819	1,408,193	9,695,012
1923	42,476,789	8,316,816	425,747	8,742,563
1924	31,809,941	6,859,785	285,251	7,145,036
1925	41,997,178	9,805,645	301,122	10,106,767
1926	71,391,717	16,421,905	357,472	16,779,377
1927	62,575,222	13,316,986	884,992	14,201,978
1928	38,847,007	8,057,107	816,368	8,873,475
1929	50,880,823	9,934,723	925,286	10,860,009

[1] Includes crude aluminum, plates, sheets, wire, etc.
[2] Includes aluminum leaf, kitchen utensils, and all other manufactures of aluminum.

Aluminum and manufactures of aluminum exported from the United States, 1920–1929

Year	Crude and semicrude [1]		Manufactures of	Total value
	Pounds	Value		
1920	9,407,631	$3,067,617	$2,563,164	$5,630,781
1921	2,196,378	801,075	2,307,782	3,108,857
1922	4,347,020	1,127,460	[2] 1,708,656	2,836,116
1923	5,539,671	1,517,562	[2] 2,053,977	3,571,539
1924	6,343,512	1,632,315	[2] 2,540,075	4,172,390
1925	12,642,034	3,365,815	[2] 2,691,256	6,057,071
1926	7,634,171	2,135,087	[3] 2,317,216	4,452,303
1927	14,522,560	3,478,649	[3] 2,828,772	6,307,421
1928	15,728,281	3,758,728	[3] 3,132,762	6,891,490
1929	17,032,117	4,149,539	[3] 3,821,546	7,971,085

[1] Includes ingots, metal and alloys, plates and sheets, etc.
[2] Represents value of 4,544,949 pounds in 1922, 5,402,034 pounds in 1923, 6,783,240 pounds in 1924, and 6,463,192 pounds in 1925 of tubes, moldings, castings, and other shapes, table, kitchen, or hospital utensils, and other manufactures. Figures of quantity not available prior to 1922.
[3] Tubes, moldings, castings, and other shapes exported amounted to 2,115,274 pounds in 1926, 1,529,615 pounds in 1927, 1,003,957 pounds in 1928, and 2,466,508 pounds in 1929; figures for quantity of table, kitchen, or hospital utensils, and other manufactures exported are not recorded.

BISMUTH

The bismuth produced in the United States is a by-product obtained in the refining of lead and tin bullion, part of which is from ores of foreign origin. Figures of production are not available for publication.

Bismuth imported for consumption in the United States, 1920–1929

Year	Pounds	Value
1920	72,771	$161,877
1921	94,085	114,891
1922 [1]	121,505	239,777
1923 [1]	62,640	146,178
1924 [1]	18,494	39,653
1925 [1]	99,694	$187,340
1926 [1]	67,505	173,285
1927 [1]	47,732	100,773
1928 [1]	41,383	77,444
1929 [1]	37,480	58,853

[1] Also 9,392 pounds of "compounds, mixtures, and salts of bismuth," valued at $8,681, imported Sept. 22 to Dec. 31, 1922. Not separately classified prior to change in tariff. Similar additional imports in 1923 were 11,731 pounds, valued at $13,717; in 1924, 10,066 pounds, $12,533; in 1925, 16,983 pounds, $18,958; in 1926, 12,864 pounds, $18,864; in 1927, 10,560 pounds, $15,080; in 1928, 8,168 pounds, $16,336; and in 1929, 3,552 pounds, $16,645.

Exports of bismuth are not separately recorded.

BORAX

[See Sodium salts (natural)]

BRIQUETS (FUEL)

Fuel briquets produced in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	567,192	$4,623,831	1925	839,370	$7,128,404
1921	398,949	3,632,301	1926	995,332	8,533,179
1922	619,425	5,444,926	1927	970,468	7,985,165
1923	696,810	5,898,698	1928	947,423	7,705,617
1924	580,470	4,986,622	1929	1,212,415	9,515,205

Briquets and other composition coals for fuels imported for consumption in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	(1)	$9	1925	6,758	$43,931
1921	66	251	1926	123,593	736,804
1922	34,862	139,382	1927	60,601	314,435
1923	19,559	103,201	1928	71,485	353,168
1924	38	443	1929	89,458	458,517

[1] 112 pounds.

BROMINE

Bromine and bromine in compounds sold or used by producers in the United States, 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	1,160,584	$745,381	1925	1,566,120	$488,406
1921	711,953	172,759	1926	1,245,760	426,837
1922	1,005,174	150,668	1927	1,756,310	564,689
1923	842,352	146,176	1928	2,164,000	649,475
1924	2,033,804	594,685	1929	6,414,620	1,759,325

Imports of bromine have been as follows: 1929, 17,573 pounds, valued at $5,804; 1928 and 1927, none; 1926, 37,839 pounds, $14,486; 1925, 8,009 pounds, $2,110; 1924, 37,318 pounds, $8,958; 1923, 782 pounds, $1,171; 1922, 1,094 pounds, $339; 1921, 300 pounds, $84. No imports were recorded for 1920.

Exports are not specifically shown.

CADMIUM

Cadmium produced in the United States, 1920–1929

Year	Metallic cadmium		Cadmium compounds	
	Pounds	Value	Estimated cadmium content (pounds)	Value
1920	129, 283	$151, 261	[1] 24, 100	[1] $37, 274
1921	68, 501	67, 131	[1] 49, 100	[1] 71, 336
1922	131, 590	143, 433	[1] 101, 100	[1] 152, 295
1923	183, 816	161, 758	(2)	(2)
1924	129, 328	77, 597	(2)	(2)
1925	502, 824	276, 553	113, 000	127, 304
1926	810, 428	429, 527	166, 600	130, 483
1927	1, 074, 654	[3] 645, 000	229, 000	191, 051
1928	1, 875, 896	1, 144, 297	239, 900	228, 013
1929	2, 481, 427	2, 009, 956	433, 300	498, 734

[1] Cadmium sulphide only.
[2] Bureau of Mines not at liberty to publish figures.
[3] Value in 1927 based on the average market quotation of 60 cents a pound.

Metallic cadmium imported for consumption in the United States, 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	------	------	1925	5	$6
1921	101	$216	1926	------	------
1922	2, 240	2, 434	1927	22, 400	13, 172
1923	16	119	1928	233, 101	128, 901
1924	1, 102	743	1929	214, 307	184, 527

Exports of cadmium are not separately recorded by the Bureau of Foreign and Domestic Commerce, and hence are not regularly available, but it is known that domestic cadmium was largely exported during the World War.

CALCIUM CHLORIDE

Calcium-magnesium chloride, from natural brines, sold by producers in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	27, 849	$539, 471	1925	67, 870	$1, 386, 639
1921	23, 672	510, 723	1926	82, 340	1, 710, 405
1922	33, 067	571, 326	1927	95, 721	1, 947, 797
1923	44, 961	663, 384	1928	102, 090	1, 995, 603
1924	58, 791	1, 164, 848	1929	114, 240	2, 097, 061

Imports of calcium chloride have been as follows: 1929, 8,236 short tons, valued at $113,573; 1928, 9,263 tons, $100,223; 1927, 6,514 tons, $85,456; 1926, 7,372 tons, $96,742; 1925, 2,253 tons, $37,121; 1924, 3,996 tons, $54,542; 1923, 3,232 tons, $48,527. From September 22 to December 31, 1922, 740 tons, valued at $8,563, was imported. Similar imports were not separately recorded prior to change in tariff.

Exports of calcium chloride were not separately recorded until 1929, when 15,425 short tons, valued at $362,658, was exported.

CARBON BLACK

Carbon black produced from natural gas in the United States, 1920–1929

Year	Number of producers reporting	Carbon black produced		Natural gas used (estimate)
		Pounds	Value at plant	M cubic feet
1920	19	51, 321, 892	$4, 032, 286	40, 599, 000
1921	23	59, 766, 315	5, 445, 878	50, 565, 000
1922	26	67, 795, 129	5, 819, 618	53, 629, 000
1923	47	138, 262, 648	11, 692, 066	109, 096, 000
1924	46	186, 872, 034	11, 564, 936	156, 514, 000
1925	42	177, 417, 378	9, 639, 585	140, 366, 000
1926	33	180, 576, 176	9, 939, 221	130, 321, 000
1927	33	198, 429, 000	10, 955, 000	144, 087, 000
1928	31	248, 790, 000	13, 782, 000	175, 137, 000
1929	35	366, 442, 000	18, 720, 000	261, 107, 000

Imports of carbon black are not separately recorded.

Exports were not separately recorded until 1925 when they were 43,182,635 pounds, valued at $3,555,769. Similar exports in 1926 were 39,210,389 pounds, $3,622,907; in 1927, 54,430,811 pounds, $4,599,734; in 1928, 77,903,153 pounds, $6,794,224; and in 1929, 91,829,215 pounds, $8,270,837.

CEMENT

Principal hydraulic cements shipped from mills in the United States, 1920–1929

Year	Masonry, natural, and puzzolan cements		Portland cement		Total	
	Barrels	Value	Barrels	Value	Barrels	Value
1920	767, 481	$1, 150, 890	96, 311, 719	$194, 439, 025	97, 079, 200	$195, 589, 915
1921	539, 402	897, 025	95, 507, 147	180, 778, 415	96, 046, 549	181, 675, 440
1922	889, 428	1, 293, 598	117, 701, 216	207, 170, 430	118, 590, 644	208, 464, 028
1923	1, 271, 674	1, 947, 352	135, 912, 118	257, 684, 424	137, 183, 792	259, 631, 776
1924	1, 418, 461	2, 006, 559	146, 047, 549	264, 046, 708	147, 466, 010	266, 053, 267
1925	1, 751, 725	2, 551, 583	157, 295, 212	278, 524, 108	159, 046, 937	281, 075, 691
1926	2, 031, 851	2, 820, 110	162, 187, 090	277, 965, 473	164, 218, 941	280, 785, 583
1927	2, 158, 323	2, 881, 029	171, 864, 728	278, 854, 647	174, 023, 051	281, 735, 676
1928	2, 213, 645	2, 910, 097	175, 838, 332	275, 972, 945	178, 051, 977	278, 883, 042
1929	2, 159, 130	2, 950, 717	169, 868, 322	252, 153, 789	172, 027, 452	255, 104, 506

Portland cement produced in the United States, 1920–1929, in barrels

Year	Barrels	Year	Barrels
1920	100, 023, 245	1925	161, 658, 901
1921	98, 842, 049	1926	164, 530, 170
1922	114, 789, 984	1927	173, 206, 513
1923	137, 460, 238	1928	176, 298, 846
1924	149, 358, 109	1929	170, 646, 036

Portland cement produced, shipped, and in stock in the United States, 1928 and 1929, by States and districts

	Production				Shipments				Stock at mills (Dec. 31) (barrels)	
	Active plants		Barrels		1928		1929		1928	1929
	1928	1929	1928	1929	Barrels	Value	Barrels	Value		
STATE										
Alabama	6	6	6,749,202	5,005,967	6,696,684	$8,233,872	5,228,947	$5,911,031	743,869	520,889
California	12	12	13,555,579	13,091,899	13,699,851	25,906,942	12,964,746	22,805,576	819,914	947,067
Illinois	4	4	7,334,833	8,242,725	7,405,667	11,602,848	7,738,208	11,134,538	697,441	1,201,958
Iowa	6	6	7,070,172	6,373,330	6,880,731	10,734,838	6,586,111	9,781,159	1,559,925	1,347,144
Kansas	7	7	6,574,219	6,739,741	6,787,568	10,091,330	6,855,861	10,041,282	911,812	795,692
Michigan	14	14	13,848,561	13,748,862	14,044,230	19,268,707	13,325,727	18,916,711	2,010,520	2,433,655
Missouri	5	5	7,881,118	8,113,304	7,943,367	12,367,018	7,984,337	11,557,905	896,878	1,025,845
New York	11	10	10,960,204	10,761,368	10,983,950	16,748,773	10,742,992	15,597,868	1,504,972	1,523,348
Ohio	10	10	9,233,033	9,427,084	9,364,338	14,928,183	9,144,085	13,427,778	1,074,074	1,357,073
Pennsylvania	26	27	41,522,401	39,354,470	41,161,019	62,572,588	39,309,662	55,600,953	5,907,235	5,952,043
Tennessee	6	6	4,689,703	4,442,249	4,634,280	6,322,213	4,537,601	5,576,235	571,018	475,666
Texas	7	9	6,345,604	7,374,428	6,231,083	10,938,646	7,083,572	11,805,779	521,924	812,780
Other States[1]	42	47	40,534,217	37,970,609	40,005,564	66,256,987	38,366,473	59,996,974	5,540,521	5,144,657
	156	163	176,298,846	170,646,036	175,838,332	275,972,945	169,868,322	252,153,789	22,760,103	23,537,817
DISTRICT										
Eastern Pennsylvania, New Jersey, and Maryland	25	25	39,677,010	37,726,967	39,738,910	60,236,388	37,647,014	53,042,469	5,113,231	5,193,184
New York and Maine	12	11	11,484,054	11,418,596	11,357,052	17,386,416	11,519,619	16,780,423	1,655,720	1,554,697
Ohio, western Pennsylvania, and West Virginia	18	19	18,326,478	17,936,179	18,037,131	28,375,472	17,737,226	25,922,200	2,835,684	3,034,637
Michigan	14	14	13,848,561	13,748,862	14,044,230	19,268,707	13,325,727	18,916,711	2,010,520	2,433,655
Wisconsin, Illinois, Indiana, and Kentucky	11	11	22,748,604	21,378,418	22,627,309	35,575,358	21,171,227	31,168,394	2,735,536	2,942,727
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	19	19	15,949,537	13,792,618	15,770,338	21,253,288	14,047,259	17,689,012	1,895,931	1,641,290
Eastern Missouri, Iowa, Minnesota, and South Dakota	12	12	16,692,696	15,697,414	16,544,026	25,777,858	15,984,176	23,430,891	2,882,044	2,595,282
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas[2]	11	13	10,938,637	12,392,722	11,221,802	17,444,193	12,267,352	18,124,275	1,333,940	1,459,310
Texas	7	9	6,345,604	7,374,428	6,231,083	10,938,646	7,083,572	11,805,779	521,924	812,780
Colorado, Montana, Utah, Wyoming,[2] and Idaho[2]	7	9	2,771,863	2,695,024	2,628,003	5,698,753	2,766,167	5,764,757	527,508	456,365
California	12	12	13,555,579	13,091,899	13,699,851	25,906,942	12,964,746	22,805,576	819,914	947,067
Oregon and Washington	8	9	3,960,223	3,392,909	3,938,597	8,110,924	3,354,237	6,703,302	428,151	466,823
	156	163	176,298,846	170,646,036	175,838,332	275,972,945	169,868,322	252,153,789	22,760,103	23,537,817

[1] Arkansas, Colorado, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maine, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, South Dakota, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

[2] Arkansas, Wyoming, and Idaho began producing and shipping in 1929.

Hydraulic cement imported into and exported from the United States, 1920–1929

Year	Imports for consumption		Exports	
	Barrels	Value	Barrels	Value
1920	524, 604	$1, 254, 729	2, 985, 807	$10, 045, 369
1921	122, 317	388, 842	1, 181, 014	4, 276, 986
1922	355, 931	692, 429	1, 127, 845	3, 206, 201
1923	1, 767, 264	3, 145, 977	1, 001, 688	2, 944, 174
1924	2, 023, 663	3, 139, 788	878, 543	2, 615, 154
1925	3, 667, 458	5, 836, 482	1, 019, 597	3, 003, 128
1926	3, 244, 223	5, 154, 926	974, 326	2, 995, 833
1927	2, 065, 730	3, 007, 103	816, 726	2, 796, 717
1928	2, 302, 475	3, 135, 558	824, 656	2, 938, 702
1929	1, 745, 345	1, 983, 974	885, 321	3, 083, 217

CHROMITE

Chromite shipped from mines in the United States, 1920–1929

Year	Long tons	Value	Year	Long tons	Value
1920	2, 502	$44, 857	1925	108	$2, 105
1921	282	2, 900	1926	141	2, 079
1922	355	7, 288	1927	[1] 201	[1] 5, 063
1923	227	3, 819	1928	660	14, 807
1924	288	1, 140	1929	269	3, 976

[1] No shipments reported by producers to the Bureau of Mines for 1927. Division of Mines and Mining, Department of Natural Resources, California, reports 225 short tons, valued at $5,063 f. o. b. shipping point, as sold in 1927.

Crude chromite imported for consumption in the United States, 1920–1929

Year	Long tons	Value	Year	Long tons	Value
1920	150, 275	$1, 921, 824	1925	149, 739	$1, 207, 420
1921	81, 836	654, 602	1926	215, 464	1, 704, 947
1922	90, 081	741, 186	1927	222, 360	1, 748, 598
1923	129, 693	1, 123, 120	1928	216, 592	1, 704, 988
1924	118, 343	1, 095, 603	1929	317, 630	2, 666, 488

There are no exports of chromite.

CLAY

Clay sold by producers in the United States, 1920–1929

Year	Kaolin or china clay and paper clay		Ball clay		Slip clay		Fire clay	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1920	268, 203	$2, 865, 407	69, 477	$584, 611	9, 006	$41, 519	2, 261, 915	$7, 088, 049
1921	162, 726	1, 579, 163	54, 014	354, 565	4, 608	14, 841	1, 195, 861	3, 560, 373
1922	275, 675	2, 346, 095	76, 792	440, 877	4, 050	19, 405	1, 679, 220	4, 633, 486
1923	336, 803	2, 926, 255	97, 068	620, 978	8, 520	43, 609	2, 298, 163	6, 565, 899
1924	326, 611	2, 923, 965	83, 034	581, 966	5, 910	31, 023	2, 443, 710	6, 737, 063
1925	367, 319	3, 220, 719	109, 607	699, 427	7, 349	37, 397	2, 566, 934	7, 312, 349
1926	432, 215	3, 771, 568	112, 195	867, 500	8, 644	45, 959	2, 819, 346	8, 119, 323
1927	454, 245	3, 809, 834	119, 763	913, 976	6, 137	32, 264	2, 699, 761	7, 719, 725
1928	496, 142	4, 088, 003	120, 878	984, 075	5, 699	30, 796	2, 785, 158	7, 480, 609
1929	518, 169	4, 281, 301	118, 190	987, 306	6, 369	38, 582	3, 178, 805	8, 107, 586

Year	Stoneware clay		Miscellaneous clay		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	106, 350	$229, 221	322, 100	$467, 856	3, 037, 051	$11, 276, 663
1921	86, 574	184, 540	242, 963	361, 818	1, 746, 746	6, 055, 300
1922	86, 866	164, 870	525, 097	725, 781	2, 647, 700	8, 330, 514
1923	81, 389	194, 358	612, 717	837, 814	3, 434, 660	11, 188, 913
1924	59, 194	117, 142	772, 660	1, 116, 377	3, 691, 119	11, 507, 536
1925	77, 438	162, 161	901, 773	1, 304, 579	4, 030, 420	12, 736, 632
1926	84, 002	185, 288	510, 796	1, 115, 951	3, 967, 198	14, 105, 589
1927	98, 355	203, 648	470, 915	1, 017, 712	3, 849, 176	13, 697, 159
1928	95, 626	207, 275	522, 829	1, 409, 981	4, 026, 332	14, 200, 739
1929	87, 456	181, 901	438, 031	1, 254, 068	4, 347, 020	14, 850, 744

Clay imported for consumption in the United States, 1920–1929

Year	Kaolin or china clay		Common blue and Gross Almerode glass-pot clay		All other clays				Total	
					Unwrought		Wrought			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1920	361, 800	$3, 568, 677	6, 837	$157, 201	34, 252	$272, 524	691	$10, 267	403, 580	$4, 008, 669
1921	162, 906	1, 546, 285	4, 468	77, 217	41, 421	348, 870	120	2, 313	208, 915	1, 974, 685
1922	310, 136	2, 963, 420	7, 323	84, 415	40, 624	327, 388	2, 566	29, 398	360, 649	3, 404, 621
1923	311, 298	3, 046, 191	12, 999	121, 272	65, 379	481, 614	1, 676	21, 892	391, 352	3, 670, 969
1924	353, 124	3, 188, 454	7, 059	62, 883	82, 562	706, 018	1, 322	18, 685	444, 067	3, 976, 040
1925	372, 552	3, 195, 694	11, 889	107, 940	49, 991	499, 325	2, 383	29, 266	436, 815	3, 832, 225
1926	396, 219	3, 484, 054	6, 608	60, 391	84, 512	672, 223	2, 331	31, 243	489, 670	4, 247, 911
1927	339, 014	2, 937, 113	3, 884	39, 451	50, 017	447, 888	1, 585	24, 518	394, 500	3, 448, 970
1928	307, 304	2, 962, 269	10, 259	90, 742	51, 163	429, 788	1, 653	23, 564	370, 379	3, 506, 363
1929	279, 981	2, 700, 296	28, 008	268, 011	49, 324	420, 689	12, 283	154, 158	369, 596	3, 543, 154

Domestic clay exported from the United States, 1920–1929

Year	Fire clay		All other		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	54,125	$393,177	66,035	$775,222	120,160	$1,168,399
1921	23,666	177,979	23,779	183,449	47,445	361,428
1922	24,391	169,664	[1] 23,285	[1] 267,908	47,676	437,572
1923	50,055	303,675	34,840	329,192	84,895	632,867
1924	41,704	312,676	31,051	420,040	72,755	732,716
1925	44,037	350,571	39,006	530,995	83,043	881,566
1926	47,737	348,302	42,157	644,416	89,894	992,718
1927	48,106	392,327	51,278	725,562	99,384	1,117,889
1928	60,138	494,241	60,911	896,350	121,049	1,390,591
1929	76,561	588,770	76,789	1,117,312	153,350	1,706,082

[1] Includes 2,091 short tons of "kaolin, china, and paper clay," valued at $27,840. Similar exports not shown separately for other years.

CLAY PRODUCTS

Value of clay products of the United States, 1920–1929 [1]

Year	Brick and tile	Pottery	Total	Year	Brick and tile	Pottery	Total
1920	$266,953,426	$106,716,676	$373,670,102	1925	$311,428,417	$112,018,500	$423,446,917
1921	186,589,507	84,149,029	270,738,536	1926	313,935,186	116,493,308	430,428,494
1922	[2] 229,508,106	91,986,297	[2] 321,494,403	1927	292,322,616	111,612,931	403,935,547
1923	309,631,561	114,951,067	424,582,628	1928	265,770,513	107,780,369	373,550,882
1924	297,764,393	118,014,985	415,779,378	1929	261,390,174	112,019,217	373,409,391

[1] Canvass discontinued by U. S. Geological Survey after 1920. Figures for 1921 to 1929 obtained through cooperation with Bureau of the Census.

[2] Includes value of "prepared clay," figures for which are not separately published.

Clay products of the United States, 1928 and 1929, by products [1]

Product	1928		1929	
	Quantity	Value	Quantity	Value
Common brick .... thousands	6,412,810	$69,332,912	5,505,359	$58,732,635
Face brick .... do	2,411,575	40,034,273	2,139,408	36,119,826
Fancy or ornamental brick .... do	146	4,065	(2)	(2)
Enameled brick .... do	15,407	1,135,266	17,137	1,259,248
Hollow brick .... do	34,202	366,746	25,803	345,380
Terra cotta .... short tons	142,720	13,641,777	133,958	13,921,244
Hollow building tile .... do	3,976,311	25,791,634	3,659,811	21,972,958
Tile (not drain)	----------	31,523,096	----------	32,845,835
Flue lining .... short tons	250,796	2,693,098	243,333	2,499,320
Conduit .... do	(2)	(2)	503,710	8,169,309
Vitrified brick or block .... thousands	378,459	7,800,090	367,650	7,503,930
Draintile .... short tons	694,205	5,256,220	858,521	6,515,718
Sewer pipe .... do	1,895,487	23,968,773	1,675,453	21,330,167
Stove lining .... do	9,706	343,907	16,805	468,248
Fire brick:				
Standard .... thousands	854,895	33,537,128	938,218	36,168,898
Special shapes .... short tons	86,671	2,518,198	182,280	4,092.295
High-alumina .... thousands	13,860	1,336,409	23,911	2,114,925
Glass-house tank blocks, melting pots, etc. short tons	35,513	1,993,609	35,912	2,276,009
Wall coping .... do	58,000	663,131	41,698	507,080
Chimney pipe and tops .... do	5,044	216,869	19,885	310,113
Segment blocks .... do	48,845	516,826	50,546	734,272
Miscellaneous	----------	3.096,486	----------	3,502,764
Total brick and tile	----------	265,770,513	----------	261,390,174
Total pottery	----------	107,780,369	----------	112,019,217
Grand total	----------	373,550,882	----------	373,409,391

[1] Figures obtained through cooperation with Bureau of the Census.

[2] Value included under "Miscellaneous."

Value of clay products of the United States, 1928 and 1929, by States [1]

State	1928				1929			
	Number of firms reporting	Brick and tile	Pottery	Total	Number of firms reporting	Brick and tile	Pottery	Total
Alabama	38	$4,066,882	$5,920	$4,072,802	39	$3,969,005	$32,628	$4,001,633
Arizona	7	297,159	------	297,159	9	506,215	------	506,215
Arkansas	15	1,580,571	(2)	[3] 1,580,571	12	1,961,215	63,188	2,024,403
California	117	16,721,960	4,271,387	20,993,347	133	18,172,606	4,561,368	22,733,974
Colorado	33	2,644,850	353,392	2,998,242	37	2,789,678	327,386	3,117,064
Connecticut	24	2,558,384	(2)	[3] 2,558,384	22	2,038,539	(2)	[3] 2,038,539
Delaware	7	274,894	------	274,894	6	230,441	------	230,441
District of Columbia	4	211,020	(2)	[3] 211,020	4	194,908	(2)	[3] 194,908
Florida	11	392,048	(2)	[3] 392,048	7	281,741	(2)	[3] 281,741
Georgia	35	3,644,931	11,558	3,656,489	28	3,691,185	26,488	3,717,673
Idaho	6	188,232	------	188,232	6	151,320	------	151,320
Illinois	129	26,328,670	5,698,215	32,026,885	120	21,427,027	5,964,041	27,391,068
Indiana	90	12,932,816	3,613,895	16,546,711	84	14,595,987	3,907,253	18,503,240
Iowa	49	5,006,623	(2)	[3] 5,006,623	43	5,770,125	(2)	[2] 5,770,125
Kansas	29	3,593,130	(2)	[3] 3,593,130	24	3,279,953	(2)	[3] 3,279,953
Kentucky	42	6,954,582	158,941	7,113,523	42	6,934,741	127,479	7,062,220
Louisiana	13	284,114	(2)	[3] 284,114	17	583,513	(2)	[3] 583,513
Maine	20	535,088	------	535,088	16	641,364	------	641,364
Maryland	24	2,161,720	2,424,905	4,586,625	26	2,455,910	2,659,906	5,115,816
Massachusetts	37	2,029,287	800,323	2,829,610	32	2,126,937	445,014	2,571,951
Michigan	34	3,019,297	3,291,289	6,310,586	35	3,076,403	3,140,615	6,217,018
Minnesota	25	1,492,792	(2)	[3] 1,492,792	19	1,584,401	501,296	2,085,697
Mississippi	26	1,094,259	35,540	1,129,799	22	1,143,917	45,225	1,189,142
Missouri	56	14,891,273	(2)	[3] 14,891,273	49	14,933,916	60,632	14,994,548
Montana	10	397,516	------	397,516	9	353,219	------	353,219
Nebraska	17	794,851	(2)	[3] 794,851	16	914,304	(2)	[3] 914,304
Nevada	1	(2)	------	(2)	1	(2)	------	(2)
New Hampshire	14	881,023	------	881,023	12	900,388	------	900,388
New Jersey	114	18,160,009	21,219,269	39,379,278	120	19,112,238	20,305,730	39,417,968
New Mexico	4	166,351	------	166,351	5	155,138	------	155,138
New York	102	15,422,513	7,051,892	22,474,405	83	11,071,518	6,590,193	17,661,711
North Carolina	63	3,787,043	39,450	3,826,493	64	3,139,723	57,107	3,196,830
North Dakota	3	167,121	------	167,121	5	174,892	------	174,892
Ohio	336	47,867,039	33,981,383	81,848,422	329	46,372,475	35,425,020	81,797,495
Oklahoma	16	1,726,369	------	1,726,369	17	1,892,919	------	1,892,919
Oregon	14	450,205	(2)	[3] 450,205	20	636,310	73,184	709,494
Pennsylvania	265	40,861,414	7,067,389	47,928,803	266	41,478,737	8,195,755	49,674,492
Rhode Island	------	------	------	------	1	(2)	------	(2)
South Carolina	24	1,448,765	13,290	1,462,055	24	1,231,106	21,711	1,252,817
South Dakota	------	------	------	------	1	(2)	------	(2)
Tennessee	34	3,134,891	895,360	4,030,251	32	2,732,166	963,671	3,695,837
Texas	58	5,992,538	184,264	6,176,802	59	5,800,531	209,648	6,010,179
Utah	11	444,536	(2)	[3] 444,536	9	1,028,342	(2)	[3] 1,028,342
Vermont	1	(2)	------	(2)	1	(2)	------	(2)
Virginia	44	2,940,832	(2)	[3] 2,940,832	45	2,948,309	(2)	[3] 2,948,309
Washington	27	1,945,317	23,609	1,968,926	29	2,520,836	46,055	2,566,891
West Virginia	46	5,019,880	14,007,665	19,027,545	45	4,782,551	15,707,704	20,490,255
Wisconsin	35	1,007,826	(2)	[3] 1,007,826	32	1,043,261	1,758,048	2,801,309
Wyoming	5	103,426	------	103,426	5	172,630	------	172,630
Undistributed	------	146,466	2,631,433	2,777,899	------	387,534	802,872	1,190,406
	2,115	265,770,513	107,780,369	373,550,882	2,062	261,390,174	112,019,217	373,409,391

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[1] Figures obtained through cooperation with Bureau of the Census.

[2] Included under "Undistributed."

[3] Exclusive of pottery, value for which is included under "Undistributed."

Value of clay products imported for consumption in the United States, 1920–1929

Year	Pottery								Brick, fire brick, tile, and miscellaneous clay products	Grand total
	Brown earthen and common stoneware [1]	Tobacco pipes and pipe bowls of clay	Earthenware and crockery composed of a nonvitrified absorbent body		China and porcelain		Sanitary earthenware, decorated and not decorated	Total		
			Not decorated	Decorated	Not decorated	Decorated				
1920	$390, 962	$12, 091	$340, 676	$3, 805, 955	$431, 636	$5, 856, 384	$13, 068	$10, 850, 772	$252, 656	$11, 103, 428
1921	288, 893	11, 535	405, 370	3, 871, 554	646, 427	6, 918, 179	12, 067	12, 154, 025	228, 804	12, 382, 829
1922	341, 997	15, 638	339, 066	4, 427, 001	641, 261	6, 298, 440	17, 295	12, 080, 698	375, 764	12, 456, 462
1923	263, 388	26, 606	881, 480	4, 916, 906	864, 239	8, 830, 266	346, 589	16, 129, 474	864, 124	16, 993, 598
1924	314, 721	14, 517	765, 070	5, 041, 570	799, 772	9, 504, 905	125, 100	16, 565, 655	690, 639	17, 256, 294
1925	401, 421	22, 385	544, 124	5, 679, 094	699, 792	9, 994, 062	5, 463	17, 346, 341	935, 507	18, 281, 848
1926	359, 951	21, 661	445, 436	6, 444, 433	623, 360	11, 383, 666	1, 873	19, 280, 380	1, 939, 843	21, 220, 223
1927	209, 736	10, 327	458, 141	7, 320, 731	578, 499	11, 875, 202	4, 950	20, 457, 586	1, 849, 355	22, 306, 941
1928	155, 539	11, 575	389, 332	6, 085, 149	476, 275	9, 338, 946	6, 626	16, 463, 442	1, 955, 629	18, 419, 071
1929	139, 864	8, 969	342, 803	7, 599, 715	522, 102	9, 443, 385	5, 990	18, 062, 828	1, 940, 347	20, 003, 175

[1] Including Rockingham ware and miscellaneous pottery products.

Value of clay products of domestic manufacture exported from the United States, 1920–1929

Year	Building brick	Fire brick	Tile (except drain)	Earthen and stoneware	China	Sanitary earthenware	All other	Total
1920	$382, 814	$4, 200, 266	$1, 025, 083	$1, 241, 938	$816, 817	$778, 714	$951, 991	$9, 397, 623
1921	415, 402	2, 314, 911	814, 456	1, 014, 329	312, 161	535, 506	873, 182	6, 279, 947
1922	210, 215	1, 581, 679	390, 408	981, 082	316, 973	561, 536	[1] 1, 599, 949	5, 641, 842
1923	282, 454	2, 332, 536	373, 866	932, 779	334, 146	657, 859	[1] 1, 915, 842	6, 829, 482
1924	222, 033	1, 463, 412	400, 452	753, 652	259, 098	745, 746	[1] 1, 863, 324	5, 707, 717
1925	194, 153	1, 323, 128	396, 088	758, 883	255, 578	788, 528	[1] 1, 041, 484	4, 757, 842
1926	176, 711	1, 406, 809	376, 162	694, 736	268, 796	1, 026, 636	[1] 1, 691, 131	5, 640, 981
1927	161, 346	3, 024, 156	391, 190	862, 396	338, 955	1, 198, 660	[1] 1, 310, 338	7, 287, 041
1928	263, 786	3, 543, 735	298, 494	817, 381	389, 675	1, 371, 005	[1] 1, 485, 776	8, 169, 852
1929	552, 687	4, 633, 121	529, 706	1, 025, 835	392, 582	1, 799, 378	[1] 2, 103, 199	11, 036, 508

[1] Includes electric porcelain valued at $1,379,750 in 1922, $1,783,614 in 1923, $1,767,323 in 1924, $949,785 in 1925, $1,541,675 in 1926, $1,201,481 in 1927, $1,375,764 in 1928, and $1,818,455 in 1929; not separately classified prior to 1922.

COAL

Coal produced in the United States, 1920–1929

Year	Pennsylvania anthracite		Bituminous		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	89, 598, 249	$434, 252, 198	568, 666, 683	$2, 129, 933, 000	658, 264, 932	$2, 564, 185, 000
1921	90, 473, 451	452, 304, 903	415, 921, 950	1, 199, 983, 600	506, 395, 401	1, 652, 288, 600
1922	54, 683, 022	273, 700, 125	422, 268, 099	1, 274, 820, 000	476, 951, 121	1, 548, 520, 000
1923	93, 339, 009	506, 786, 768	564, 564, 662	1, 514, 621, 000	657, 903, 671	2, 021, 408, 000
1924	87, 926, 862	477, 230, 852	483, 686, 538	1, 062, 626, 000	571, 613, 400	1, 539, 857, 000
1925	61, 817, 149	327, 664, 512	520, 052, 741	1, 060, 402, 000	581, 869, 890	1, 388, 067, 000
1926	84, 437, 452	474, 164, 252	573, 366, 985	1, 183, 412, 000	657, 804, 437	1, 657, 576, 000
1927	80, 095, 564	420, 941, 726	517, 763, 352	1, 029, 657, 000	597, 858, 916	1, 450, 599, 000
1928	75, 348, 069	393, 637, 690	500, 744, 970	933, 774, 000	576, 093, 039	1, 327, 412, 000
1929	73, 828, 195	385, 642, 751	534, 988, 593	952, 781, 000	608, 816, 788	1, 338, 424, 000

Coal produced in the United States, 1928 and 1929, by States

[Exclusive of product of wagon mines]

State	1928		1929	
	Short tons	Value	Short tons	Value
Alabama	17,621,362	$39,601,000	17,943,923	$37,309,000
Alaska	126,100	662,000	100,610	528,000
Arizona	3,600	16,000	10,132	44,000
Arkansas	1,660,973	5,615,000	1,695,108	5,624,000
California, Idaho, Nevada,[1] and Oregon	23,888	70,000	10,322	37,000
Colorado	9,847,707	27,613,000	9,920,741	26,254,000
Georgia	58,390	181,000	44,636	136,000
Illinois	55,948,199	112,095,000	60,657,641	113,453,000
Indiana	16,378,580	29,212,000	18,344,358	29,880,000
Iowa	3,683,635	10,525,000	4,241,069	11,948,000
Kansas	2,809,724	6,861,000	2,975,971	6,697,000
Kentucky	61,860,379	96,722,000	60,462,600	93,283,000
Maryland	2,686,979	4,954,000	2,649,114	4,640,000
Michigan	617,342	2,631,000	804,869	2,904,000
Missouri	3,732,421	9,637,000	4,030,311	9,778,000
Montana	3,324,195	7,550,000	3,407,526	7,561,000
New Mexico	2,711,851	8,636,000	2,622,769	8,314,000
North Carolina	60,860	201,000	52,180	177,000
North Dakota	1,649,930	2,780,000	1,862,130	3,157,000
Ohio	15,641,225	26,439,000	23,689,477	35,733,000
Oklahoma	3,501,325	10,365,000	3,774,080	11,481,000
Pennsylvania, bituminous	131,202,163	249,895,000	143,516,241	258,607,000
South Dakota	13,929	39,000	12,854	38,000
Tennessee	5,610,959	9,694,000	5,405,464	9,122,000
Texas	1,182,034	1,589,000	1,100,668	1,600,000
Utah	4,842,544	12,253,000	5,160,521	12,725,000
Virginia	11,900,933	20,375,000	12,748,306	20,942,000
Washington	2,519,901	8,720,000	2,521,327	8,647,000
West Virginia	132,952,159	211,480,000	138,518,855	215,110,000
Wyoming	6,571,683	17,363,000	6,704,790	17,052,000
Total bituminous	500,744,970	933,774,000	534,988,593	952,781,000
Pennsylvania anthracite	75,348,069	393,637,690	73,828,195	385,642,751
Grand total	576,093,039	1,327,412,000	608,816,788	1,338,424,000

[1] No production reported from Nevada for 1928.

Coal produced in the United States, 1928 and 1929, by months, in short tons

Month	Pennsylvania anthracite		Bituminous	
	1928	1929	1928	1929
January	5,587,000	7,068,000	44,925,000	52,398,000
February	5,481,000	6,425,000	42,022,000	48,137,000
March	5,398,000	4,859,000	44,668,000	40,068,000
April	6,784,000	6,205,000	32,710,000	37,565,000
May	7,977,000	6,077,000	37,218,000	40,908,000
June	5,205,000	4,883,000	36,546,000	38,771,000
July	4,394,000	4,810,000	36,864,000	41,379,000
August	6,759,000	5,735,000	41,774,000	44,695,000
September	5,927,000	6,543,000	41,971,000	45,334,000
October	8,400,000	8,026,000	51,176,000	52,174,000
November	7,322,000	5,820,000	46,788,000	46,514,000
December	6,114,000	7,377,000	44,083,000	47,046,000
	75,348,000	73,828,000	500,745,000	534,989,000

Coal imported for consumption in the United States, 1920–1929

Year	Anthracite		Bituminous		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	31, 748	$257, 835	1, 244, 990	$6, 733, 676	1, 276, 738	$6, 991, 511
1921	8, 894	93, 103	1, 257, 589	7, 363, 945	1, 266, 483	7, 457, 048
1922	233, 528	1, 502, 192	5, 059, 999	26, 747, 374	5, 293, 527	28, 249, 566
1923	300, 360	2, 114, 080	1, 881, 465	10, 128, 516	2, 181, 825	12, 242, 596
1924	117, 914	880, 364	416, 736	2, 135, 402	534, 650	3, 015, 766
1925	382, 894	3, 212, 505	601, 737	2, 633, 980	984, 631	5, 846, 485
1926	813, 956	6, 996, 739	485, 298	2, 300, 570	1, 299, 254	9, 297, 309
1927	119, 030	837, 033	548, 278	2, 435, 212	667, 308	3, 272, 245
1928	384, 707	2, 591, 041	547, 505	2, 402, 083	932, 212	4, 993, 124
1929	487, 172	3, 328, 838	495, 218	2, 157, 364	982, 390	5, 486, 202

Coal exported from the United States, 1920–1929

Year	Anthracite		Bituminous [1]		Total [1]	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	5, 403, 749	$45, 538, 100	38, 517, 084	$304, 273, 241	43, 920, 833	$349, 811, 341
1921	4, 677, 368	45, 624, 555	23, 131, 166	122, 597, 038	27, 808, 534	168, 221, 593
1922	2, 649, 457	25, 350, 677	12, 413, 085	65, 891, 740	15, 062, 542	91, 242, 417
1923	5, 090, 138	49, 577, 339	21, 453, 579	104, 546, 585	26, 543, 717	154, 123, 924
1924	4, 017, 785	40, 067, 804	17, 100, 347	70, 971, 302	21, 118, 132	111, 039, 106
1925	3, 179, 006	31, 760, 627	17, 461, 560	68, 402, 668	20, 640, 566	100, 163, 295
1926	4, 029, 683	41, 085, 946	35, 271, 937	155, 818, 572	39, 301, 620	196, 904, 518
1927	3, 325, 507	32, 927, 796	18, 011, 744	71, 328, 924	21, 337, 251	104, 256, 720
1928	3, 336, 272	32, 656, 523	16, 164, 485	59, 464, 348	19, 500, 757	92, 120, 871
1929	3, 406, 369	32, 568, 523	17, 429, 298	65, 741, 852	20, 835, 667	98, 310, 375

[1] Exclusive of bunker coal, which has been as follows: 1920, 10,485,639 tons, $82,461,518; 1921, 8,453,220 tons, $52,277,668; 1922, 4,614,632 tons, $27,912,957; 1923, 5,093,024 tons, $31,469,788; 1924, 4,460,412 tons, $22,883,293; 1925, 4,865,521 tons, $23,397,831; 1926, 7,735,606 tons, $38,025,411; 1927, 4,565,278 tons, $22,077,203; 1928, 4,294,223 tons, $20,558,057; 1929, 4,286,519 tons, $19,575,095.

COBALT

No cobalt ores are known to have been produced in the United States in 1922 to 1929. Production in other years of the decade 1920 to 1929 has been as follows: 1920, 102,410 pounds of cobalt in oxide and hydrate, valued at $262,801, was recovered from ore mined near Fredericktown, Mo.; 1921, 42,086 pounds of heterogenite (cobalt oxide), containing 4,018 pounds of cobalt, was mined near Goodsprings, Nev.; it was shipped in 1922 and sold for $1,419.

Cobalt ore, cobalt, and oxide imported for consumption in the United States, 1920–1929

Year	Ore		Cobalt		Oxide		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1920	13, 039	$4, 794	143, 603	$326, 864	202, 724	$399, 605	[1] 359, 586	[1] $731, 277
1921	7, 657	3, 235	38, 442	105, 539	164, 003	342, 426	210, 102	451, 200
1922	5, 195	7, 075	126, 364	321, 396	217, 530	435, 895	[2] 349, 089	[2] 764, 366
1923	58, 719	56, 326	225, 639	552, 434	258, 574	511, 903	[2] 542, 932	[2] 1,120, 663
1924	28, 786	37, 276	118, 952	264, 935	226, 703	440, 898	[2] 374, 441	[2] 743, 109
1925	34, 782	31, 320	198, 669	422, 185	287, 265	546, 292	[2] 520, 716	[2] 999, 797
1926	154, 468	55, 820	387, 076	820, 873	333, 132	632, 478	[1, 2] 874,786	[1, 2] 1,509,211
1927	60, 382	3, 019	407, 198	841, 442	369, 747	703, 608	[2] 837, 327	[2] 1,548, 069
1928	107, 498	25, 922	535, 817	1, 147, 574	364, 154	692, 753	[2] 1,007,469	[2] 1,866, 249
1929	434, 443	51, 862	806, 640	1, 743, 465	475, 928	884, 873	[2] 1,717,011	[2] 2,680, 200

[1] Includes 220 pounds of zaffer, valued at $14, in 1920, and 110 pounds, valued at $40, in 1926. No zaffer imported 1921 to 1925 and 1927 to 1929.

[2] Also 11 pounds of "other salts and compounds," valued at $26, imported Sept. 22 to Dec. 31, 1922. Not separately classified prior to change in tariff. Similar additional imports in 1923 were 45,644 pounds, valued at $27,356; in 1924, 797 pounds, $856; in 1925, 13,256 pounds, $7,894; in 1926, 37,342 pounds, $21,647; in 1927, 55,127 pounds, $28,681; in 1928, 68,281 pounds, $39,993; and in 1929, 64,782 pounds, $37,548.

COKE AND COKE-OVEN BY-PRODUCTS

COKE

Coke produced in the United States, 1920–1929

Year	Beehive		By-product		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	20, 511, 092	$162, 952, 483	30, 833, 951	$313, 028, 732	51, 345, 043	$475, 981, 215
1921	5, 538, 042	30, 166, 449	19, 749, 580	117, 506, 646	25, 287, 622	147, 673, 095
1922	8, 573, 467	50, 036, 556	28, 550, 545	188, 276, 767	37, 124, 012	238, 313, 323
1923	19, 379, 870	115, 905, 580	37, 597, 664	257, 591, 318	56, 977, 534	373, 496, 898
1924	10, 286, 037	48, 351, 552	33, 983, 568	195, 690, 009	44, 269, 605	244, 041, 561
1925	11, 354, 784	51, 731, 566	39, 912, 159	210, 827, 571	51, 266, 943	262, 559, 137
1926	12, 488, 951	57, 024, 869	44, 376, 586	250, 748, 533	56, 865, 537	307, 773, 402
1927	7, 207, 417	30, 276, 775	43, 884, 726	232, 043, 803	51, 092, 143	262, 320, 578
1928	4, 492, 803	16, 318, 556	48, 313, 025	236, 515, 204	52, 805, 828	252, 833, 760
1929	6, 472, 019	22, 564, 424	53, 411, 826	256, 430, 168	59, 883, 845	278, 994, 592

Coke produced in the United States, 1928 and 1929, by States

State	1928		1929	
	Short tons	Value [1]	Short tons	Value [1]
Alabama	4, 327, 324	$13, 260, 178	4, 753, 967	$12, 659, 148
Colorado	750, 022	(2)	721, 457	(2)
Connecticut	(3)	(3)	(3)	(3)
Georgia	(3)	(3)		
Illinois	3, 240, 964	19, 967, 463	4, 204, 116	26, 036, 197
Indiana	6, 094, 201	38, 237, 790	6, 455, 378	41, 208, 876
Kentucky	(3)	(3)	(3)	(3)
Maryland	1, 186, 398	(2)	1, 393, 052	(2)
Massachusetts	687, 356	5, 269, 890	776, 679	5, 919 159
Michigan	2, 399, 656	13, 461, 466	2, 679, 971	14, 867, 651
Minnesota	622, 696	5, 816, 566	746, 004	6, 478, 228
Missouri	(3)	(3)	(3)	(3)
New Jersey	903, 177	(2)	897, 530	(2)
New York	3, 802, 657	25, 033, 649	4, 299, 470	25, 305, 915
Ohio	(3)	(3)	[4] 8, 521, 132	[4] 35, 202, 383
Pennsylvania	16, 917, 355	62, 647, 772	[5] 19, 856, 968	[5] 72, 913, 229
Rhode Island	(3)	(3)	(3)	(3)
Tennessee	216, 925	1, 063, 887	209, 166	1, 086, 374
Utah	274, 600	(2)	281, 994	(2)
Virginia	247, 734	1, 052, 016	311, 859	1, 283, 740
Washington	59, 502	437, 187	66, 723	493, 827
West Virginia	1, 798, 900	5, 305, 393	1, 928, 583	5, 286, 427
Wisconsin	(3)	(3)	(3)	(3)
Combined States	9, 276, 361	43, 997, 601	1, 776, 796	12, 668, 372
Undistributed		17, 282, 902		17, 585, 066
	52, 805, 828	252, 833, 760	59, 883, 845	278, 994, 592

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[1] Includes operators' statements of value for that portion of product not sold (such as coke consumed by producer in associated iron furnaces).

[2] Included under "Undistributed."

[3] Included under "Combined States."

[4] By-product only; beehive included with Pennsylvania.

[5] A small amount of beehive coke, produced in Ohio, is included with Pennsylvania.

Coke produced in the United States, 1928 and 1929, by States and kinds

State	Beehive				By-product			
	1928		1929		1928		1929	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama					4, 327, 324	$13, 260, 178	4, 753, 967	$12, 659, 148
Colorado	144, 200	(1)	156, 426	(1)	605, 822	(1)	565, 031	(1)
Connecticut					(2)	(2)	(2)	(2)
Georgia	(2)	(2)						
Illinois					3, 240, 964	19, 967, 463	4, 204, 116	26, 036, 197
Indiana					6, 094, 201	38, 237, 790	6, 455, 378	41, 208, 876
Kentucky	(2)	(2)			(2)	(2)	(2)	(2)
Maryland					1, 186, 398	(1)	1, 393, 052	(1)
Massachusetts					687, 356	5, 269, 890	776, 679	5, 919, 159
Michigan					2, 399, 656	13, 461, 466	2, 679, 971	14, 867, 651
Minnesota					622, 696	5, 816, 566	746, 004	6, 478, 228
Missouri					(2)	(2)	(2)	(2)
New Jersey					903, 177	(1)	897, 530	(1)
New York					3, 802, 657	25, 033, 649	4, 299, 470	25, 305, 915
Ohio	(2)	(2)	(3)	(3)	7, 786, 199	33, 908, 863	8, 521, 132	35, 202, 383
Pennsylvania	3, 442, 006	$11, 515, 366	[3]5, 367, 685	[3]$17,824,426	13, 475, 349	51, 132, 406	14, 489, 283	55, 088, 803
Rhode Island					(2)	(2)	(2)	(2)
Tennessee	103, 791	457, 489	95, 881	413, 461	113, 134	606, 398	113, 285	672, 913
Utah	28, 097	(1)	14, 055	(1)	246, 503	(1)	267, 939	(1)
Virginia	247, 734	1, 052, 016	314, 859	1, 283, 740				
Washington	18, 747	151, 902	25, 844	207, 674	40, 755	285, 285	40, 879	286, 153
West Virginia	431, 419	1, 543, 933	497, 269	1, 675, 544	1, 367, 481	3, 761, 460	1, 431, 314	3, 610, 883
Wisconsin					(2)	(2)	(2)	(2)
Combined States	76, 809	406, 691			1, 413, 353	9, 682, 047	1, 776, 796	12, 668, 372
Undistributed		1, 191, 159		1, 159, 579		16, 091, 743		16, 425, 487
	4, 492, 803	16, 318, 556	6, 472, 019	22, 564, 424	48, 313, 025	236, 515, 204	53, 411, 826	256, 430, 168

[1] Included under "Undistributed."

[2] Included under "Combined States."

[3] A small amount of beehive coke, produced in Ohio, is included with Pennsylvania.

Coke produced in the United States, 1928 and 1929, by months, in short tons

Month	1928			1929		
	Beehive	By-product	Total	Beehive	By-product	Total
January	385, 000	3, 906, 000	4, 291, 000	515, 500	4, 355, 000	4, 870, 500
February	400, 000	3, 731, 000	4, 131, 000	473, 700	4, 084, 800	4, 558, 500
March	459, 000	4, 074, 000	4, 533, 000	574, 000	4, 607, 600	5, 181, 600
April	387, 000	3, 934, 000	4, 321, 000	503, 200	4, 451, 700	4, 954, 900
May	386, 000	4, 109, 000	4, 495, 000	642, 800	4, 658, 700	5, 301, 500
June	311, 000	3, 970, 000	4, 281, 000	648, 200	4, 504, 200	5, 152, 400
July	280, 000	3, 920, 000	4, 200, 000	645, 800	4, 608, 200	5, 254, 000
August	297, 000	4, 004, 000	4, 301, 000	604, 500	4, 637, 300	5, 241, 800
September	322, 000	3, 967, 000	4, 289, 000	542, 600	4, 407, 700	4, 950, 300
October	431, 000	4, 229, 000	4, 660, 000	505, 900	4, 604, 600	5, 110, 500
November	427, 000	4, 142, 000	4, 569, 000	444, 700	4, 316, 400	4, 761, 100
December	408, 000	4, 327, 000	4, 735, 000	371, 100	4, 175, 600	4, 546, 700
	4, 493, 000	48, 313, 000	52, 806, 000	6, 472, 000	53, 411, 800	59, 883, 800

Coke imported into and exported from the United States, 1920–1929

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1920	41, 143	$403, 175	919, 802	$9, 993, 665
1921	30, 990	336, 394	306, 755	2, 760, 939
1922	94, 228	802, 987	511, 541	4, 319, 538
1923	85, 002	862, 596	1, 237, 342	11, 889, 897
1924	82, 833	795, 477	659, 350	4, 926, 478
1925	201, 579	1, 609, 474	953, 812	6, 871, 962
1926	284, 548	2, 174, 350	987, 260	6, 979, 896
1927	168, 859	1, 371, 568	806, 664	5, 430, 704
1928	147, 701	1, 132, 855	1, 097, 666	7, 394, 531
1929	119, 724	1, 092, 235	1, 238, 035	7, 840, 368

COKE-OVEN BY-PRODUCTS

By-products from coke-oven operations in the United States, 1928 and 1929

[Exclusive of screenings and breeze]

Product	Produced	Sold	
		Quantity	Value
1928			
Tar……gallons	631, 844, 767	332, 150, 270	$17, 544, 797
Ammonia:			
Sulphate……pounds	1, 387, 895, 214	1, 318, 369, 804	24, 826, 744
Ammonia liquor (NH_3 content)……do	52, 469, 456	52, 584, 975	2, 513, 312
Sulphate equivalent of all forms……do	(1, 597, 773, 038)	(1, 528, 709, 704)	27, 340, 056
Gas:			
Distributed through city mains……M cu. ft	[1] 775, 512, 939	125, 131, 465	39, 935, 641
Used in steel or affiliated plant……do		286, 132, 946	31, 509, 424
Used under boilers, etc……do		18, 620, 112	1, 132, 547
Sold for industrial use……do		24, 588, 049	3, 921, 245
			76, 498, 857
Light oil and derivatives:			
Crude light oil……gallons	[2] 188, 597, 956	10, 334, 813	1, 158, 846
Benzol, crude and refined……do	21, 451, 748	21, 452, 973	4, 215, 752
Motor benzol……do	103, 051, 900	102, 935, 995	16, 832, 646
Toluol, crude and refined……do	16, 097, 856	16, 181, 650	5, 513, 624
Solvent naphtha and xylol……do	5, 587, 370	4, 471, 141	1, 047, 095
Other light-oil products……do	3, 114, 531	1, 388, 106	111, 844
			28, 879, 807
Naphthalene, crude and refined……pounds	12, 182, 143	10, 937, 429	135, 693
Other products	----------	----------	910, 318
	----------	----------	151, 309, 528
1929			
Tar……gallons	680, 864, 366	333, 557, 501	16, 982, 406
Ammonia:			
Sulphate……pounds	1, 488, 314, 447	1, 433, 465, 592	25, 861, 479
Ammonia liquor (NH_3 content)……do	56, 028, 347	55, 470, 678	2, 820, 802
Sulphate equivalent of all forms……do	(1, 712, 427, 835)	(1, 655, 348, 304)	28, 682, 281
Gas:			
Distributed through city mains……M cu. ft	[1] 843, 148, 089	160, 560, 921	46, 994, 632
Used in steel or affiliated plant……do		302, 165, 465	31, 901, 504
Used under boilers, etc……do		18, 506, 502	1, 282, 327
Sold for industrial use……do		26, 357, 691	4, 125, 807
			84, 304, 270
Light oil and derivatives:			
Crude light oil……gallons	[2] 200, 594, 027	11, 090, 709	1, 374, 527
Benzol, crude and refined……do	24, 944, 531	24, 558, 745	5, 169, 743
Motor benzol……do	105, 923, 762	100, 807, 852	16, 063, 285
Toluol, crude and refined……do	18, 343, 295	17, 064, 206	6, 580, 176
Solvent naphtha and xylol……do	7, 131, 111	6, 581, 047	1, 591, 333
Other light-oil products……do	6, 675, 386	1, 877, 176	124, 948
			30, 904, 012
Naphthalene, crude and refined……pounds	19, 761, 382	19, 659, 367	320, 272
Other products	----------	----------	2, 482, 330
	----------	----------	163, 675, 571

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[1] Inclusive of gas wasted and gas used for heating retorts.

[2] Of the crude light oil 182,998,384 gallons in 1928 and 194,882,679 gallons in 1929 was refined on the premises to make the derived products listed.

COLUMBITE

[See Tantalum]

COPPER [1]

Summary of statistics of the copper industry in the United States, 1927–1929

	1927	1928	1929
Production of copper:			
Smelter output from domestic ores.....pounds	1, 684, 040, 983	1, 825, 900, 393	2, 002, 863, 135
Mine production.....do	1, 649, 959, 370	1, 809, 796, 907	1, 995, 110, 398
Refinery production of new copper—			
Electrolytic.....do	1, 520, 076, 181	1, 607, 120, 026	1, 785, 754, 654
Lake.....do	195, 135, 199	179, 104, 311	185, 300, 917
Casting.....do	3, 740, 819	5, 573, 050	11, 676, 718
Total domestic.....do	1, 718, 952, 199	1, 791, 797, 387	1, 982, 732, 289
Total domestic and foreign.....do	2, 325, 763, 709	2, 487, 607. 779	2, 740, 112, 376
Total new and old copper.....do	3, 306, 000, 000	3, 560, 000, 000	3, 993, 000, 000
Ore produced:			
Copper ore.....short tons	56, 725, 460	62, 097, 132	[2] 68, 421, 853
Average yield of copper.....per cent	1. 41	1. 41	1. 41
Copper-lead and copper-lead-zinc ores.....short tons	418, 601	351, 131	259, 126
Average price per pound.....cents	13. 1	14. 4	17. 6
General imports (unmanufactured).....pounds	718, 322, 990	787, 073, 640	974, 312, 201
Exports of metallic copper [3].....do	1, 069, 493, 121	1, 121, 186, 640	992, 895, 119
Withdrawn from total supply on domestic account:			
Total new copper.....pounds	1, 422, 959, 219	1, 608, 538, 878	1, 778, 585, 415
Total new and old copper.....do	2, 403, 000, 000	2, 681, 000, 000	3, 032, 000, 000
Stocks at end of year:			
Refined copper.....do	171, 000, 000	114, 000, 000	306, 000, 000
Blister and material in solution.....do	401, 000, 000	423, 000, 000	500, 000, 000
World production (smelter).....do	3, 348, 821, 000	3, 769, 904, 000	4, 199, 805, 000
Value of smelter production from domestic ores	$220, 609, 000	$262, 930, 000	$352, 504, 000

[1] For prices of copper, see statement on p. A12.

[2] Includes old tailings.

[3] Total exports of copper, exclusive of ore, concentrates, composition metal, and unrefined copper for which figures are not separable from those for ore and concentrates; also exclusive of "Other manufactures of copper" for which figures for quantity are not recorded.

Copper produced in the United States from domestic ores, 1920–1929

[Smelter output, in pounds fine]

Year	Pounds	Value	Year	Pounds	Value
1920	1, 209, 061, 040	$222, 467, 000	1925	1, 674, 869, 886	$237, 832, 000
1921	505, 586, 098	65, 221, 000	1926	1, 739, 622, 094	243, 547, 000
1922	950, 285, 947	128, 289, 000	1927	1, 684, 040, 983	220, 609, 000
1923	1, 434, 999, 962	210, 945, 000	1928	1, 825, 900, 393	262, 930, 000
1924	1, 634, 249, 192	214, 087, 000	1929	2, 002, 863, 135	352, 504, 000

Copper produced in the United States from domestic ores, 1925–1929, by States

[Smelter output, in pounds fine]

State	1925	1926	1927	1928	1929
Alaska	72, 204, 166	67, 631, 846	56, 489, 214	40, 541, 968	39, 867, 940
Arizona	722, 653, 457	729, 324, 537	681, 168, 117	735, 632, 406	829, 206, 475
California	46, 943, 604	30, 442, 961	25, 802, 603	24, 707, 992	33, 084, 232
Colorado	3, 163, 211	4, 657, 591	8, 006, 801	10, 262, 083	10, 519, 784
Idaho	3, 144, 064	1, 171, 262	1, 811, 103	2, 336, 654	6, 267, 487
Michigan	138, 029, 764	174, 778, 884	195, 135, 199	179, 104, 311	185, 300, 917
Missouri	12, 114	54, 378	5, 041	930	1, 880
Montana	270, 604, 676	257, 271, 936	225, 208, 853	251, 046, 415	299, 894, 853
Nevada	77, 137, 563	109, 041, 769	118, 298, 342	159, 332, 977	138, 990, 247
New Mexico	76, 467, 245	82, 848, 096	79, 761, 222	92, 777, 233	100, 165, 206
North Carolina	----------	1, 468, 746	5, 362, 041	8, 207, 000	(1)
Oregon	126, 107	279, 223	484, 652	375, 049	739, 151
Pennsylvania	562, 240	495, 698	2, 149, 182	5, 013, 868	3, 581, 393
Tennessee	19, 789, 234	18, 601, 586	14, 498, 951	16, 374, 261	(1)
Texas	785	17, 102	25, 460	432, 968	393, 740
Utah	242, 730, 986	259, 649, 158	267, 705, 597	298, 375, 465	325, 965, 289
Vermont	----------	446, 323	238, 143	----------	752, 200
Washington	1, 184, 807	1, 336, 617	1, 766, 953	1, 197, 340	1, 569, 260
Wyoming	331	----------	----------	2, 575	4, 305
Undistributed	115, 532	104, 381	123, 509	178, 898	26, 558, 776
	1, 674, 869, 886	1, 739, 622, 094	1, 684, 040, 983	1, 825, 900, 393	2, 002, 863, 135

[1] Included under "Undistributed." Bureau of Mines not at liberty to publish figures.

Primary and secondary copper produced by regular refining plants in the United States and imported, 1925–1929, in pounds

	1925	1926	1927	1928	1929
Primary:					
Domestic[1]—					
Electrolytic	1, 533, 995, 439	1, 553, 041, 424	1, 520, 076, 181	1, 607, 120, 026	1, 785, 754, 654
Lake	138, 029, 764	172, 372, 304	195, 135, 199	179, 104, 311	185, 300, 917
Casting	10, 870, 144	5, 883, 433	3, 740, 819	5, 573, 050	11, 676, 718
	1, 682, 895, 347	1, 731, 297, 161	1, 718, 952, 199	1, 791, 797, 387	1, 982, 732, 289
Foreign[1]—					
Electrolytic	516, 632, 530	588, 932, 788	605, 748, 329	693, 787, 036	756, 555, 087
Casting and best select	5, 045, 947	2, 255, 427	1, 063, 181	2, 023, 356	825, 000
Total refinery production of new copper	2, 204, 573, 824	2, 322, 485, 376	2, 325, 763, 709	2, 487, 607, 779	2, 740, 112, 376
Imports of refined copper	99, 773, 546	170, 565, 766	103, 279, 082	84, 730, 630	134, 014, 792
Total new refined copper made available	2, 304, 347, 370	2, 493, 051, 142	2, 429, 042, 791	2, 572, 338, 409	2, 874, 127, 168
Secondary:					
Electrolytic	140, 349, 541	163, 061, 465	168, 766, 566	191, 323, 029	331, 858, 103
Casting	58, 010, 653	62, 056, 941	41, 102, 000	41, 322, 776	2, 300, 000
	198, 360, 194	225, 118, 406	209, 868, 566	232, 645, 805	334, 158, 103
	2, 502, 707, 564	2, 718, 169, 548	2, 638, 911, 357	2, 804, 984, 214	3, 208, 285, 271

[1] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.

In addition to their output of metallic copper, the regular refining companies produced bluestone having copper content as follows: 1925, 6,754,000 pounds; 1926, 8,498,000 pounds; 1927, 9,180,000 pounds; 1928, 11,326,000 pounds; 1929, 10,255,000 pounds.

Stocks of copper in the United States, January 1, 1921–1930, in pounds

Year	Refined copper	Blister and material in process of refining	Year	Refined copper	Blister and material in process of refining
1921	659, 000, 000	465, 000, 000	1926	124, 000, 000	432, 000, 000
1922	459, 000, 000	283, 000, 000	1927	146, 000, 000	455, 000, 000
1923	216, 000, 000	361, 000, 000	1928	171, 000, 000	401, 000, 000
1924	264, 000, 000	432, 000, 000	1929	114, 000, 000	423, 000, 000
1925	243, 000, 000	393, 000, 000	1930	306, 000, 000	500, 000, 000

New refined copper withdrawn from total year's supply on domestic account in the United States, 1925–1929, in pounds

	1925	1926	1927	1928	1929
Total supply of new copper	2, 304, 347, 370	2, 493, 051, 142	2, 429, 042, 791	2, 572, 338, 409	2, 874, 127, 168
Stocks at beginning of year	243, 000, 000	124, 000, 000	146, 000, 000	171, 000, 000	114, 000, 000
Total available supply	2, 547, 347, 370	2, 617, 051, 142	2, 575, 042, 791	2, 743, 338, 409	2, 988, 127, 168
Copper exported	1, 022, 335, 279	900, 914, 935	981, 083, 572	1, 020, 799, 531	903, 541, 753
Stocks at end of year	124, 000, 000	146, 000, 000	171, 000, 000	114, 000, 000	306, 000, 000
	1, 146, 335, 279	1, 046, 914, 935	1, 152, 083, 572	1, 134, 799, 531	1, 209, 541, 753
Withdrawn on domestic account	1, 401, 012, 091	1, 570, 136, 207	1, 422, 959, 219	1, 608, 538, 878	1, 778, 585, 415

Copper (in unmanufactured form) imported for consumption in the United States, 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	480, 297, 985	$88, 782, 609	1925	651, 005, 759	$83, 948, 686
1921	350, 582, 746	45, 660, 326	1926	779, 437, 231	99, 679, 746
1922	542, 932, 525	65, 786, 811	1927	718, 322, 990	84, 769, 961
1923	671, 929, 223	95, 398, 681	1928	787, 081, 063	97, 965, 353
1924	765, 685, 592	95, 608, 460	1929	974, 076, 610	153, 414, 829

Copper (unmanufactured) imported into the United States, 1928 and 1929, in pounds

[General imports]

Country	Ore (copper content)	Concentrates (copper content)	Matte and regulus (copper content)	Unrefined black blister and converter copper in pigs or converter bars	Refined in ingots, plates, or bars	Old and scrap fit only for remanufacture	Composition metal, copper chief value
1928							
Africa:							
Belgian Congo				113, 999, 871			
British—							
East				4, 701, 706			
Union of South	721, 110	54, 160		2, 868, 195		31, 200	
Portuguese (Mozambique)				13, 906, 012			
Australia	315, 987			54, 000			
Canada	48, 084, 775	1, 040, 490		95, 681, 502	150, 124	7, 883, 497	17, 713
Chile	34, 275, 132	328, 328	12, 437	95, 767, 272	83, 733, 020	15, 230	
Cuba	2, 740, 181	11, 438, 200				550, 618	
France	275, 790	128, 269	40, 842	52, 120	33, 506	27, 537	
Germany	300, 986	78, 833		170, 441	769, 180	92, 179	164, 563
Mexico	7, 756, 953	26, 296, 272	2, 536, 922	95, 691, 530		87, 887	
Peru	927, 218		50, 283	115, 595, 856			
Spain	9, 054, 542	59, 387		279, 639			
United Kingdom	202, 217			3, 668, 875		1, 383, 251	
Venezuela						41, 978	
Other	1, 536, 831	48, 610		753, 121	44, 800	519, 130	33, 332
	106, 191, 722	39, 472, 549	2, 640, 484	543, 190, 140	84, 730, 630	10, 632, 507	215, 608
Total value	$11, 589, 484	$4, 860, 595	$284, 656	$67, 595, 061	$12, 634, 463	$969, 382	$31, 718
1929							
Africa:							
Belgian Congo	263, 720			55, 091, 068			
British (Union of South)	30, 805	179, 999					
Portuguese (Mozambique)	931	2, 900	52, 924	7, 803, 865			
Australia	186, 762						
Canada	54, 844, 182	5, 833, 620	217, 780	132, 519, 194	679, 315	11, 394, 168	5, 002
Chile	40, 534, 646	1, 071, 394		164, 265, 111	133, 082, 539	14, 812	
Cuba	339, 713	9, 810, 270				1, 091, 152	
France	1, 185, 755	1, 111, 870		3, 717, 719	20, 616	49, 625	
Germany	1, 653, 882	1, 418, 540	105, 665	7, 114, 367	232, 322	151, 644	74, 214
Mexico	1, 447, 954	29, 909, 338	890, 490	138, 174, 222		148, 426	
Peru	7, 005, 284	50, 594	74, 096	117, 772, 651		27, 509	
Spain	14, 633, 315			2, 246, 767			
United Kingdom	1, 019, 777	9, 903		14, 435, 473		10, 280	560
Venezuela						91, 696	
Other	1, 472, 286	4, 330, 397	763, 500	3, 026, 618		618, 854	120
	124, 619, 012	53, 728, 825	2, 104, 455	646, 167, 055	134, 014, 792	13, 598, 166	79, 896
Total value	$15, 358, 271	$7, 907, 180	$292, 316	$104, 306, 141	$23, 757, 421	$1, 823, 464	$12, 064

Copper exported from the United States, 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	624, 053, 701	$127, 468, 606	1925	1, 084, 208, 532	$161, 165, 820
1921	628, 804, 750	85, 351, 928	1926 [1]	965, 685, 261	139, 853, 365
1922	743, 039, 888	103, 874, 007	1927 [1]	1, 076, 729, 246	149, 114, 730
1923	829, 314, 002	129, 219, 975	1928 [1]	1, 125, 019, 417	168, 525, 383
1924	1, 116, 915, 484	156, 645, 684	1929 [1]	998, 474, 549	181, 684, 409

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[1] Exclusive of "Other manufactures of copper," valued at $1,350,391 in 1926, at $1,098,886 in 1927, at $1,296,996 in 1928, and at $1,720,363 in 1929, for which quantity is not recorded.

Copper exported from the United States, 1928 and 1929, in pounds

Country	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined		Old and scrap	Pipes and tubes	Plates and sheets	Wire (except insulated)	Insulated wire and cable	Other manufactures of copper
		Bars, ingots, or other forms	Rods						
1928									
Belgium		77, 431, 816	2, 678, 650	333, 078	249	420	4, 438	39, 410	(1)
Canada	154, 093	21, 161, 866	25, 033, 498	5, 015, 354	2, 369, 599	2, 420, 475	1, 743, 056	2, 664, 428	
China		5, 892, 175		40, 964		33, 439	259, 513	211, 136	
Denmark		1, 998, 350	1, 457, 494		3, 450	644	224, 789	52, 734	
France	22, 415	171, 440, 871	1, 166, 340	3, 715, 460	221	112, 366	120, 287	114, 233	
Germany	2, 041, 492	206, 549, 919	33, 584	23, 581, 476	229	504, 061	2, 552, 020	43, 840	
India (British)		2, 449, 157	324, 209	449, 130	10, 267	279, 695	525, 157	293, 034	
Italy	1, 345, 580	116, 547, 931	224, 397	262, 123	440	279, 181	533, 684	447, 423	
Japan		32, 395, 333	47, 572	10, 421, 220		19, 031	237, 401	102, 699	
Netherlands	154, 116	64, 526, 417	2, 525, 531	7, 972, 816	5, 762	404, 036	508, 628	196, 355	
Norway	72, 527	2, 405, 799	2, 602, 047	41, 219		1, 959	284	20, 730	
Spain		3, 321, 076	2, 701	1, 312, 277	1, 260	650	141, 070	122, 305	
Sweden		28, 704, 670	226, 367				1, 956	13, 693	
Switzerland		705, 289					1, 438	4, 988	
United Kingdom	41, 754	185, 816, 840	26, 954, 825	2, 082, 591	25, 448	724, 996	193, 159	1, 015, 801	
Other	800	28, 126, 947	8, 047, 860	238, 847	1, 137, 316	1, 258, 504	8, 628, 871	14, 308, 296	
	3, 832, 777	949, 474, 456	71, 325, 075	55, 466, 555	3, 554, 241	6, 039, 457	15, 675, 751	19, 651, 105	(1)
Total value	$508, 112	$140, 339, 589	$11, 066, 251	$6, 994, 196	$901, 336	$1, 275, 305	$2, 623, 986	$4, 816, 608	$1, 296, 996
1929									
Belgium		45, 749, 962	2, 533, 960	614, 347			1, 360	35, 455	(1)
Canada	597, 049	38, 691, 880	22, 171, 079	4, 462, 840	2, 569, 479	3, 107, 052	1, 739, 064	3, 042, 952	
China		5, 604, 022		54, 480	5, 613	18, 006	596, 815	384, 296	
Denmark		1, 776, 102	336, 208			3, 528	18, 543	33, 839	
France		175, 264, 821	2, 500, 331	2, 654, 547	617		48, 686	132, 179	
Germany	375, 550	178, 879, 194	72, 372	19, 189, 236	243	672, 451	609, 875	12, 338	
India (British)		4, 043, 059	90, 513	157, 290	31, 569	14, 281	353, 961	450, 979	
Italy		84, 491, 310	313, 944	279, 512		651, 664	681, 485	1, 231, 826	
Japan		7, 953, 500	46, 601	4, 128, 957	3, 032	3, 475	186, 561	178, 484	
Netherlands	33, 997	32, 534, 775	5, 436, 278	2, 960, 086	6, 881	112, 497	60, 901	103, 191	
Norway		1, 366, 156	2, 573, 618	26, 400	5, 351		16, 038	21, 846	
Spain		2, 252, 963		1, 073, 444	5, 731		60, 029	53, 148	
Sweden		32, 495, 033	504, 674	12, 503			225, 500	8, 308	
Switzerland		336, 398					1, 382	4, 358	
United Kingdom	4, 536, 574	175, 449, 512	31, 713, 323	1, 958, 092	12, 888	870, 509	1, 049, 690	1, 499, 122	
Other	36, 260	35, 565, 237	12, 794, 928	63, 755	804, 670	869, 256	11, 218, 746	17, 888, 127	
	5, 579, 430	822, 453, 924	81, 087, 829	37, 635, 489	3, 446, 074	6, 322, 719	16, 868, 636	25, 080, 448	(1)
Total value	$935, 604	$148, 435, 789	$14, 584, 737	$5, 675, 750	$967, 462	$1, 576, 383	$3, 332, 229	$6, 176, 455	$1, 720, 363

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[1] Figures for quantity not recorded.

CORUNDUM

[See Abrasive materials]

CRYOLITE

No natural cryolite is produced in the United States, the entire supply in this country being imported from Greenland. Artificial cryolite is produced by electrochemical processes.

Cryolite imported for consumption in the United States, 1920–1929

Year	Long tons	Value
1920	3,864	$193,638
1921	3,460	295,186
1922	3,899	196,302
1923	6,375	319,959
1924	6,320	320,670
1925	9,844	$690,651
1926	7,599	557,598
1927	5,064	410,876
1928	6,906	529,176
1929	7,778	670,841

DIATOMITE (INFUSORIAL EARTH)

[See Abrasive materials]

EMERY

[See Abrasive materials]

FELDSPAR

Crude feldspar sold or used by producers in the United States, 1920–1929

Year	Long tons	Value
1920	135,551	$851,123
1921	91,865	617,652
1922	117,127	844,568
1923	145,004	1,057,595
1924	204,772	1,509,339
1925	185,706	$1,315,654
1926	209,989	1,607,101
1927	202,497	1,424,755
1928	210,811	1,418.975
1929	197,699	1,276,640

The foreign trade of the United States in feldspar is small and limited largely to importing from Canada. Imports have been as follows: 1929, 29,927 long tons of crude feldspar, valued at $241,852; 1928, 27,857 tons, $224,920; 1927, 27,424 tons, $206,856; 1926, 29,941 tons, $251,896; 1925, 24,994 tons, $203,524; 1924, 35,139 tons, $284,716; 1923, 24,271 tons, $184,924. Prior to September 22, 1922, imports of feldspar were not specifically classified in the official records and are therefore unknown. From that date to the end of the year the imports amounted to 7,549 long tons of crude, valued at $60,111, and 37 long tons of crushed or ground, valued at $538. No imports of crushed or ground feldspar were recorded from 1923 to 1925 but 36 long tons, valued at $1,743, was imported in 1926; 250 pounds, valued at $3, in 1927; 49 long tons, valued at $1,091, in 1928; and 3 long tons, valued at $131, in 1929.

There is no record of exports of feldspar and if any feldspar is exported the quantity is doubtless negligible.

FERRO-ALLOYS

Ferro-alloys shipped from furnaces in the United States, 1920–1929, in long tons

Year	Ferromanganese	Spiegeleisen	Other varieties	Total	
				Quantity	Value
1920	276, 594	103, 672	232, 542	612, 808	$77, 519, 367
1921	111, 374	69, 230	68, 023	248, 627	21, 697, 785
1922	161, 612	70, 253	191, 415	423, 280	28, 259, 004
1923	226, 365	134, 086	219, 366	579, 817	49, 877, 231
1924	232, 821	76, 179	188, 244	497, 244	43, 249, 948
1925	254, 005	95, 890	266, 327	616, 222	53, 048, 100
1926	330, 070	82, 982	276, 206	689, 258	61, 368, 407
1927	291, 056	80, 892	274, 801	646, 749	55, 163, 574
1928	310, 122	116, 911	367, 662	794, 695	66, 578, 039
1929	334, 162	123, 146	372, 016	829, 324	75, 506, 078

Ferro-alloys shipped from furnaces in the United States, 1928 and 1929

Variety of alloy	1928		1929	
	Long tons	Value	Long tons	Value
Ferromanganese	310, 122	$29, 199, 990	334, 162	$33, 184, 012
Spiegeleisen	116, 911	2, 802, 108	123, 146	3, 336, 703
Ferrosilicon (7 per cent or more silicon)	310, 770	15, 199, 746	310, 280	15, 730, 950
Ferrotungsten	1, 975	3, 195, 690	3, 049	5, 828, 760
Ferrovanadium	1, 895	5, 085, 759	1, 767	4, 665, 720
Other varieties [1]	53, 022	11, 094, 746	56, 920	12, 759, 933
	794, 695	66, 578, 039	829, 324	75, 506, 078

[1] Ferrochromium, ferromolybdenum and calcium-molybdenum compounds, ferrophosphorus, ferrotitanium, ferrozirconium, silicomanganese, silicospiegeleisen, and zirconium-ferrosilicon.

Value of ferro-alloys imported for consumption in the United States, 1920–1929

1920	$10, 397, 896	1925	$7, 133, 618
1921	1, 576, 131	1926	6, 303, 757
1922	7, 789, 632	1927	4, 752, 552
1923	9, 879, 433	1928	6, 158, 449
1924	5, 509, 020	1929	8, 609, 080

Ferro-alloys imported for consumption in the United States, 1928 and 1929

Variety of alloy	1928		1929	
	Long tons	Value	Long tons	Value
Ferromanganese (manganese content)	48, 844	$4, 899, 374	56, 969	$6, 126, 056
Spiegeleisen	5, 260	147, 406	13, 828	403, 853
Ferrochrome and chromium:				
Ferrochrome—				
Containing 3 per cent or more carbon (chromium content)	69	15, 344	37	8, 835
Containing less than 3 per cent carbon	611	170, 069	638	206, 311
Chrome or chromium metal	10	2, 508	21	5, 242
Ferrosilicon (silicon content)	4, 697	649, 739	9, 285	1, 388, 423
Molybdenum and ferromolybdenum (molybdenum content)	(1)	1, 385	1	2, 384
Titanium and ferrotitanium	17	6, 067	7	2, 517
Tungsten and ferrotungsten (tungsten content)	50	50, 849	211	376, 230
Ferrovanadium	107	215, 708	46	89, 229
	---------	6, 158, 449	---------	8, 609, 080

[1] 576 pounds.

Ferro-alloys exported from the United States, 1920–1929

Variety of alloy	1920		1921		1922		1923		1924	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Ferromanganese	3, 454	$642, 570	690	$100, 474	1, 107	$76, 822	4, 295	$151, 224	3, 165	$92, 421
Spiegeleisen	(1)	(1)	(1)	(1)	289	7, 740				
Ferrochrome and chrome metal	(1)	(1)	(1)	(1)	23	1, 941	(2)	(2)	(2)	(2)
Ferrosilicon	632	41, 057	368	20, 204	689	30, 939	814	31, 154	775	29, 214
Tungsten and ferrotungsten	2	5, 913	------	--------	(3)	43, 219	[4] 2	[4] 122,906	[4] 2	[4] 114,775
Ferrovanadium	173	705, 385	98	424, 886	22	69, 279	23	64, 713	25	81, 016

Variety of alloy	1925		1926		1927		1928		1929	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Ferromanganese	5, 496	$160, 568	693	$44, 111	1, 641	$61, 793	9, 440	$232, 990	1, 574	$59, 036
Spiegeleisen										
Ferrochrome and chrome metal	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Ferrosilicon	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Tungsten and ferrotungsten (including tungsten wire)	6	143, 987	13	155, 653	9	164, 917	7	123, 354	46	325, 133
Ferrovanadium	46	106, 754	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)

[1] Not separately classified prior to 1922.
[2] Not separately recorded.
[3] 1,009 pounds.
[4] Includes tungsten wire.

FLUORSPAR

Fluorspar shipped from mines in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	186, 778	$4, 718, 547	1925	113, 669	$2, 052, 342
1921	34, 960	724, 094	1926	128, 657	2, 341, 277
1922	141, 596	2, 531, 165	1927	112, 546	2, 034, 728
1923	121, 188	2, 505, 819	1928	140, 490	2, 656, 554
1924	124, 979	2, 451, 131	1929	146, 439	2, 791, 126

Fluorspar shipped from mines in the United States, 1927–1929, by States

State	1927		1928		1929	
	Short tons	Value	Short tons	Value	Short tons	Value
Illinois	46, 006	$863, 909	65, 884	$1, 154, 983	67, 009	$1, 284, 834
Kentucky	57, 495	1, 040, 338	69, 747	1, 426, 766	70, 827	1, 390, 603
Colorado	6, 432	130, 481	1, 815	74, 805	4, 808	56, 607
New Mexico	2, 613		2, 589		2, 438	59, 082
Nevada	------------	------------	455		1, 357	
	112, 546	2, 034, 728	140, 490	2, 656, 554	146, 439	2, 791, 126

Fluorspar imported for consumption in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	24, 612	$265, 630	1925	48, 770	$469, 540
1921	6, 229	69, 306	1926	75, 626	746, 479
1922	33, 108	299, 188	1927	71, 242	594, 082
1923	41, 884	429, 696	1928	47, 450	409, 841
1924	50, 821	551, 842	1929	54, 345	480, 999

No exports of fluorspar have been reported by Bureau of Foreign and Domestic Commerce. Producers have reported exports, as follows:

Fluorspar reported by producers as exported from the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	2,764	$65,475	1925	1,055	$17,574
1921	----------	----------	1926	2,132	34,915
1922	2,296	40,966	1927	385	7,507
1923	1,144	25,312	1928	398	6,586
1924	617	14,489	1929	506	11,621

FULLER'S EARTH

Fuller's earth sold or used by producers in the United States, 1920–1929

Year	Number of operators	Short tons	Value	Year	Number of operators	Short tons	Value
1920	12	128,487	$2,506,189	1925	14	206,574	$2,923,965
1921	12	105,609	1,973,848	1926	14	234,152	3,356,482
1922	15	138,944	2,289,719	1927	16	264,478	3,767,038
1923	15	149,134	2,247,523	1928	17	287,012	3,895,991
1924	13	177,994	2,632,342	1929	17	315,983	4,309,723

Fuller's earth imported for consumption in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	19,015	$221,893	1925	8,015	$111,295
1921	9,744	119,415	1926	9,098	123,674
1922	10,569	135,695	1927	7,580	109,281
1923	8,547	113,944	1928	7,593	132,003
1924	7,302	92,488	1929	8,302	152,432

Exports of fuller's earth are not reported separately.

GARNET (ABRASIVE)

[See Abrasive materials]

GAS (NATURAL)

Natural gas produced in the United States and delivered to consumers, 1920–1929

[Value at point of consumption]

Year	M cubic feet	Value	Year	M cubic feet	Value
1920	798,210,000	$196,194,000	1925	1,188,571,000	$265,271,000
1921	662,052,000	174,617,000	1926	1,313,019,000	300,168,000
1922	762,546,000	221,535,000	1927	1,445,428,000	317,930,000
1923	1,006,976,000	240,001,000	1928	1,568,139,000	363,726,000
1924	1,141,521,000	253,856,000	1929	1,917,693,000	413,276,00

Natural gas produced in the United States and delivered to consumers, 1928 and 1929, by States

[Value at point of consumption]

State	1928		1929	
	M cubic feet	Value	M cubic feet	Value
Arkansas	20, 235, 000	$3, 562, 000	19, 928, 000	$3, 802, 000
California	246, 215, 000	56, 695, 000	342, 214, 000	68, 972, 000
Colorado	2, 931, 000	786, 000	2, 787, 000	675, 000
Illinois	3, 051, 000	360, 000	2, 983, 000	388, 000
Indiana	1, 290, 000	639, 000	1, 012, 000	518, 000
Kansas	45, 644, 000	14, 144, 000	38, 469, 000	13, 429, 000
Kentucky	15, 383, 000	5, 349, 000	27, 588, 000	8, 822, 000
Louisiana	227, 821, 000	20, 279, 000	261, 138, 000	26, 505, 000
Michigan	469, 000	149, 000	4, 526, 000	900, 400
Mississippi	(1)	(1)	90, 000	32, 000
Missouri	360, 000	217, 000	324, 000	164, 000
Montana	6, 277, 000	1, 446, 000	9, 659, 000	2, 377, 000
New Mexico	838. 000	66, 000	3, 054, 000	536, 000
New York	7, 224, 000	4, 827, 000	8, 387, 000	5, 538, 000
Ohio	56, 341, 000	32, 090, 000	57, 936, 000	32, 890. 000
Oklahoma	320, 861, 000	47, 476, 000	357, 893, 000	53, 528. 000
Pennsylvania	99, 466, 000	48, 432, 000	101, 951, 000	48, 821, 000
South Dakota	54, 000	53, 000	99, 000	40, 000
Tennessee	(1)	(1)	25, 000	10, 700
Texas	301, 990, 000	51, 316, 000	464, 928, 000	67, 474, 000
Utah	1, 105, 000	22, 000	693, 000	205, 000
West Virginia	163, 018, 000	72, 265, 000	167, 333, 000	73, 793, 000
Wyoming	47, 490, 000	3, 527, 000	44, 648. 000	3, 850, 000
Other [2]	76, 000	26, 000	28, 000	5, 900
	1, 568, 139, 000	363, 726, 000	1, 917, 693, 000	413, 276, 000

[1] Included under "Other."

[2] 1928: Alaska, Mississippi, North Dakota, and Tennessee; 1929: Alaska, Iowa, North Dakota, and Washington.

GASOLINE FROM NATURAL GAS

Natural gasoline produced in the United States, 1920–1929

Year	Raw (unblended) gasoline produced		Natural gas treated (estimated) (M cubic feet)
	Gallons	Value at plant	
1920	384, 743, 922	$71, 788, 122	496, 431, 000
1921	449, 934, 402	61, 815, 258	465, 097, 000
1922	505, 832, 000	72, 711, 063	545, 139, 000
1923	816, 226, 000	77, 268, 000	875, 711, 000
1924	933, 861, 000	82, 233, 000	1, 016, 276, 000
1925	1, 127, 470, 000	120, 383, 000	1, 040, 390, 000
1926	1, 363, 090, 000	136, 412, 000	1, 206, 300, 000
1927	1, 641, 144, 000	118. 688, 000	1, 341, 248, 000
1928	1, 814, 034, 000	138, 944, 000	1, 473, 434, 000
1929	2, 233, 688, 000	158, 410, 000	1, 959, 294, 000

Natural gasoline produced in the United States, 1928 and 1929, by States

State	1928		1929	
	Gallons	Value	Gallons	Value
Alaska	26, 000	$3, 000	35, 000	$4, 000
Arkansas	32, 677, 000	2, 568, 000	33, 455, 000	2, 419, 000
California	584, 111, 000	53, 885, 000	840, 325, 000	67, 009, 000
Colorado	1, 909, 000	136, 000	1, 630, 000	113, 000
Illinois	7, 817, 000	585, 000	7, 080, 000	617, 000
Indiana			2, 000	(1)
Kansas	36, 765, 000	2, 444, 000	36, 227, 000	2, 207, 000
Kentucky	7, 267, 000	575, 000	6, 006, 000	486, 000
Louisiana	55, 022, 000	3, 434, 000	64, 957, 000	4, 010, 000
New Mexico	1, 506, 000	107, 000	1, 077, 000	71, 000
New York	392, 000	45, 000	264, 000	22, 000
Ohio	13, 174, 000	1, 146, 000	11, 166, 000	923, 000
Oklahoma	619, 691, 000	40, 959, 000	676, 030, 000	42, 766, 000
Pennsylvania	16, 571, 000	1, 570, 000	18, 411, 000	1, 676, 000
Texas	324, 516, 000	22, 492, 000	419, 485, 000	26, 561, 000
West Virginia	69, 729, 000	6, 220, 000	72, 994, 000	6, 285, 000
Wyoming	42, 861, 000	2, 775, 000	44, 544, 000	3, 241, 000
	1, 814, 034, 000	138, 944, 000	2, 233, 688, 000	158, 410, 000

[1] Less than $500.

GEMS AND PRECIOUS STONES

Value of precious stones produced in the United States, 1920–1923 [1]

Year	Value	Year	Value
1920	$265, 205	1922	[2] $71, 106
1921	[2] 518, 280	1923 (estimate)	65, 000

[1] Canvass discontinued after 1923.
[2] Production of diamond in Arkansas not reported.

Value of diamonds and other precious stones imported for consumption in the United States, 1920–1929

Year	Diamonds				Other stones not set	Total, excluding pearls	Pearls
	Glazier's	Dust and bort	Rough or uncut	Cut but not set			
1920	$1, 527, 753	$3, 387, 488	$10, 526, 125	$45, 240, 013	$5, 419, 363	$66, 100, 742	$7, 879, 384
1921	435, 872	466, 345	2, 207, 365	26, 144, 323	2, 778, 931	32, 032, 836	4, 492, 063
1922	839, 882	1, 029, 261	8, 332, 416	43, 144, 742	3, 723, 062	57, 069, 363	8, 546, 574
1923	1, 065, 834	228, 409	7, 241, 550	51, 975, 896	5, 703, 279	66, 214, 968	7, 932, 929
1924	1, 116, 862	259, 482	11, 666, 587	47, 108, 169	5, 214, 130	65, 365, 230	5, 898, 560
1925	1, 976, 640	760, 476	9, 492, 328	49, 723, 818	5, 228, 011	67, 181, 273	6, 734, 149
1926	1, 939, 735	271, 382	13, 070, 767	51, 353, 168	6, 333, 779	72, 968, 831	5, 322, 140
1927	2, 148, 275	62, 045	11, 452, 439	40, 714, 672	4, 529, 350	58, 906, 781	6, 043, 162
1928	2, 756, 895	31, 222	11, 903, 815	42, 368, 172	3, 822, 140	60, 882, 244	7, 082, 034
1929	4, 067, 674	89, 363	9, 588, 137	41, 828, 581	9, 398, 183	64, 971, 938	10, 345, 420

Domestic exports in 1922 were as follows: "Diamonds, cut but not set," 15 carats, valued at $1,540; "other precious stones, including pearls," $21,525. Data are not separately classified prior to 1922. For 1923 to 1929, domestic exports are recorded as "Precious stones, including pearls," as follows: 1923, $78,967; 1924, $146,825; 1925, $39,823; 1926, $64,377; 1927, $87,291; 1928, $72,296; 1929, $47,316.

Value of foreign precious stones reexported from the United States, 1920–1929

Year	Diamonds [1]		Other precious stones [1]		Total, excluding pearls	Pearls and parts of, not strung or set
	Uncut	Cut but not set	Uncut [1]	Cut but not set		
1920			[1] $4,604	$13,338	$17,942	$8,000
1921		$896	[1] 14,390	9,353	24,639	128
1922	$19,735	1,396	[1] 7,387	7,546	36,064	728
1923–1929	(2)	(2)	(2)	(2)	(2)	(2)

[1] Bort included under "Other precious stones—uncut."

[2] Foreign exports for 1923 to 1925 are recorded as "Diamonds and precious stones," as follows: 1923, 535,840 carats, valued at $27,123; 1924, 47,797 carats, $69,230; 1925, 32,959 carats, $26,983. Beginning 1926 they are recorded as "Precious stones and imitations," and valued as follows: 1926, $57,304; 1927, $62,494; 1928, $42,513; 1929, $41,845.

GOLD AND SILVER [1]

Gold and silver produced in the United States, 1920–1929

Year	Gold		Silver	
	Troy ounces	Value	Troy ounces	Value
1920	2,476,166	$51,186,900	55,361,573	$60,801,955
1921	2,422,006	50,067,300	53,052,441	53,052,441
1922	2,363,075	48,849,100	56,240,048	56,240,048
1923	2,502,632	51,734,000	73,335,170	60,134,839
1924	2,528,900	52,277,000	65,407,186	43,822,814
1925	2,411,987	49,860,200	66,155,424	45,911,864
1926	2,335,042	48,269,600	62,718,746	39,136,497
1927	2,197,125	45,418,600	60,434,441	34,266,328
1928	2,233,251	46,165,400	58,462,507	34,200,567
1929	2,208,386	45,651,400	61,327,868	32,687,754

[1] Gold is valued by law at $20.67+a troy ounce. For prices of silver, see statement on p. A12.

Gold produced in the United States, 1928 and 1929, by States [1]

State	1928		1929	
	Troy ounces	Value [2]	Troy ounces	Value [2]
Alabama			10	$200
Alaska	330,604	$6,834,200	374,669	7,745,100
Arizona	189,519	3,917,700	211,108	4,364,000
California	513,249	10,609,800	409,020	8,455,200
Colorado	258,564	5,345,000	220,285	4,553,700
Georgia	34	700	58	1,200
Idaho	20,351	420,700	19,597	405,100
Montana	59,661	1,233,300	55,854	1,154,600
Nevada	177,730	3,674,000	158,941	3,285,600
New Mexico	34,961	722,700	33,026	682,700
North Carolina	131	2,700	174	3,600
Oregon	11,865	245,300	17,657	365,000
Pennsylvania	987	20,400	745	15,400
Philippine Islands	88,531	1,830,100	151,757	3,137,100
South Carolina	10	200		
South Dakota	318,095	6,575,600	312,328	6,456,400
Tennessee	537	11,100	653	13,500
Texas	556	11,500	1,263	26,100
Utah	211,418	4,370,400	237,221	4,903,800
Washington	16,414	339,300	3,972	82,100
Wyoming	34	700	48	1,000
	2,233,251	46,165,400	2,208,386	45,651,400

[1] Figures furnished by the Bureau of the Mint.

[2] Gold value, $20.67+ a troy ounce.

Silver produced in the United States, 1928 and 1929, by States [1]

State	1928		1929	
	Troy ounces	Value [2]	Troy ounces	Value [2]
Alaska	486, 859	$284, 812	478, 973	$255, 293
Arizona	6, 564, 933	3, 840, 486	7, 840, 321	4, 178, 891
California	1, 467, 088	858, 246	1, 194, 651	636, 749
Colorado	4, 384, 072	2, 564, 682	4, 415, 838	2, 353, 642
Georgia	5	3	13	7
Idaho	8, 949, 716	5, 235, 584	9, 533, 327	5, 081, 263
Illinois	2, 677	1, 566	4, 146	2, 210
Michigan	18, 707	10, 944	17, 899	9, 540
Missouri	158, 280	92, 594	146, 638	78, 158
Montana	10, 681, 675	6, 248, 780	12, 613, 580	6, 723, 038
Nevada	5, 312, 610	3, 107, 877	4, 746, 750	2, 530, 018
New Mexico	925, 449	541, 388	1, 060, 494	565, 243
North Carolina	19, 141	11, 197	14, 414	7, 683
Oregon	31, 858	18, 637	37, 840	20, 169
Pennsylvania	7, 428	4, 345	5, 616	2, 993
Philippine Islands	36, 503	21, 354	94, 547	50, 394
South Dakota	91, 697	53, 643	84, 465	45, 020
Tennessee	75, 907	44, 406	96, 146	51, 246
Texas	1, 394, 665	815, 879	1, 042, 273	555, 531
Utah	17, 749, 317	10, 383, 350	17, 844, 657	9, 511, 202
Vermont	----------	----------	3, 633	1, 936
Washington	103, 907	60, 786	51, 639	27, 524
Wyoming	13	8	8	4
	58, 462, 507	34, 200, 567	61, 327, 868	32, 687, 754

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[1] Figures furnished by the Bureau of the Mint.

[2] Valued at average New York price of bar silver, as follows: 1928, 58.5 cents an ounce; 1929, 53.3 cents an ounce.

Value of gold and silver imported into and exported from the United States, 1920–1929

Year	Gold		Silver	
	Imports	Exports	Imports	Exports
1920	$417, 068, 273	$322, 091, 208	$88, 060, 041	$113, 616, 224
1921	691, 248, 297	23, 891, 377	63, 242, 671	51, 575, 399
1922	275, 169, 785	36, 874, 894	70, 806, 653	62, 807, 286
1923	322, 715, 812	28, 643, 417	74, 453, 530	72, 468, 789
1924	319, 720, 918	61, 648, 313	73, 944, 902	109, 891, 033
1925	128, 273, 172	262, 639, 790	64, 595, 418	99, 127, 585
1926	213, 504, 020	115, 707, 815	69, 595, 936	92, 257, 564
1927	207, 535, 195	201, 455, 100	55, 073, 917	75, 624, 780
1928	168, 897, 307	560, 759, 341	68, 117, 329	87, 382, 016
1929	291, 648, 632	116, 582, 926	63, 939, 830	83, 407, 197

Value of gold and silver imported into and exported from the United States, 1928 and 1929, by classes

	Imports	Exports	Excess of—	
			Imports	Exports
1928				
Gold:				
Contained in domestic ore and base bullion		$268, 517		$268, 517
Contained in foreign ore and base bullion	$14, 499, 910		$14, 499, 910	
Domestic bullion refined		411, 892, 524		411, 892, 524
Foreign bullion refined	102, 455, 023	5, 200, 226	97, 254, 797	
United States coin	47, 870, 221	143, 225, 401		95, 355, 180
Foreign coin	4, 072, 153	172, 673	3, 899, 480	
	168, 897, 307	560, 759, 341	115, 654, 187	507, 516, 221
Excess exports over imports				391, 862, 034
Silver:				
Contained in domestic ore and base bullion		51, 769		51, 769
Contained in foreign ore and base bullion	37, 331, 651		37, 331, 651	
Domestic bullion refined		64, 051, 823		64, 051, 823
Foreign bullion refined	28, 476, 770	20, 620, 905	7, 855, 865	
United States coin	1, 622, 489	225, 210	1, 397, 279	
Foreign coin	686, 419	2, 432, 309		1, 745, 890
	68, 117, 329	87, 382, 016	46, 584, 795	65, 849, 482
Excess exports over imports				19, 264, 687
1929				
Gold:				
Contained in domestic ore and base bullion		57, 787		57, 787
Contained in foreign ore and base bullion	17, 459, 761		17, 459, 761	
Domestic bullion refined	28, 129, 908	109, 228, 470		81, 098, 562
Foreign bullion refined	129, 962, 247	1, 372	129, 960, 875	
United States coin	96, 920, 998	7, 145, 173	89, 775, 825	
Foreign coin	19, 175, 718	150, 124	19, 025, 594	
	291, 648, 632	116, 582, 926	256, 222, 055	81, 156, 349
Excess imports over exports			175, 065, 706	
Silver:				
Contained in domestic ore and base bullion		5, 202		5, 202
Contained in foreign ore and base bullion	33, 487, 387		33, 487, 387	
Domestic bullion refined		62, 788, 418		62, 788, 418
Foreign bullion refined	24, 994, 216	13, 515, 301	11, 478, 915	
United States coin	2, 068, 861	44, 131	2, 024, 730	
Foreign coin	3, 389, 366	7, 054, 145		3, 664, 779
	63, 939, 830	83, 407, 197	46, 991, 032	66, 458, 399
Excess exports over imports				19, 467, 367

GRAPHITE

Natural graphite sold or used by producers in the United States, 1920–1929

Year	Amorphous		Crystalline	
	Short tons	Value	Pounds	Value
1920	4, 694	$49, 758	9, 632, 360	$576, 444
1921	1, 842	20, 860	1, 189, 523	75, 664
1922	2, 200	(1)	1, 849, 766	85, 242
1923	4, 056	39, 560	3, 964, 900	151, 434
1924	4, 071	38, 533	1, 800, 325	48, 977
1925	3, 536	39, 640	2, 257, 250	56, 721
1926	2, 975	40, 500	4, 989, 200	178, 842
1927	2, 595	35, 850	5, 224, 400	197, 121
1928	2, 994	43, 320	5, 233, 300	253, 773
1929	3, 555	46, 650	5, 806, 410	264, 241

[1] Bureau of Mines not at liberty to publish value.

Graphite imported for consumption in the United States, 1920–1929, by kinds

Year	Amorphous		Crystalline chip or dust		Crystalline flake		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1920	(1)	(1)	(1)	(1)	(1)	(1)	21,095	$1,711,312
1921							8,183	452,076
1922							12,488	473,046
1923	11,252	$149,831	7,243	$426,417	939	$37,871	19,434	614,119
1924	10,936	113,751	3,998	197,867	1,441	87,893	16,375	399,511
1925 [2]	9,210	143,750	5,904	389,242	2,654	293,418	17,768	[2] 826,410
1926 [2]	8,250	161,564	5,258	433,848	2,658	325,821	16,166	[2] 921,233
1927 [2]	9,559	146,881	6,116	390,822	1,777	186,220	17,452	[2] 723,923
1928 [2]	7,699	107,936	7,143	452,424	2,727	241,199	17,569	[2] 801,559
1929 [2]	12,041	189,198	8,304	546,668	3,727	330,968	24,072	[2] 1,066,834

[1] Not separately classified prior to 1923.

[2] Imports of graphite crucibles were not separately classified until 1925 when 3,100 crucibles, valued at $548, were imported; corresponding imports for 1926 were 9,513 crucibles, $11,780; for 1927, 2,583 crucibles, $1,812; for 1928, 2,368 crucibles, $1,245; and for 1929, 7,640 crucibles, $1,156; weight not recorded.

Graphite exported from the United States, 1920–1929

Year	Unmanufactured graphite		Manufactures of graphite [1]	Year	Unmanufactured graphite		Manufactures of graphite [1]
	Short tons	Value			Short tons	Value	
1920	607	$112,771	$610,261	1925	945	$142,122	$337,481
1921	921	95,998	679,359	1926	405	49,235	463,084
1922	569	78,094	255,019	1927	[2] 1,819	[2] 435,997	(2)
1923	908	138,542	335,778	1928	[2] 2,203	[2] 454,770	(2)
1924	1,022	144,108	250,957	1929	[2] 1,613	[2] 370,013	(2)

[1] After 1921, exclusive of crucibles, figures for which are not available.

[2] Classification for 1927, 1928, and 1929 reads "Graphite and manufactures, except crucibles."

GRINDSTONES AND PULPSTONES

[See Abrasive materials]

GYPSUM

Gypsum produced in the United States and sold by producers, 1920–1929

Year	Crude produced (short) tons)	Crude and calcined sold (total value)	Year	Crude produced (short tons)	Crude and calcined sold (total value)
1920	3,129,142	$24,533,065	1925	5,678,302	$47,577,240
1921	2,890,784	23,700,290	1926	5,635,441	46,721,219
1922	3,779,949	29,361,151	1927	5,346,888	42,174,454
1923	4,753,448	34,888,155	1928	5,102,250	32,036,163
1924	5,042,629	42,724,507	1929	5,016,132	31,292,969

Gypsum imported for consumption in the United States, 1920–1929

Year	Crude		Ground or calcined		Value of manufactured plaster of Paris	Keenes cement		Total value
	Short tons	Value	Short tons	Value		Short tons	Value	
1920	282,486	$397,942	14,921	$179,191	$10,282	202	$5,338	$592,753
1921	266,796	364,318	4,495	55,109	33,072	184	6,836	459,335
1922	409,475	523,939	1,774	32,651	55,116	403	9,636	621,342
1923	448,129	629,203	5,133	77,716	41,317	418	11,543	759,779
1924	519,627	724,864	5,217	70,793	48,059	539	12,042	855,758
1925	634,423	915,888	10,759	140,941	56,724	449	11,294	1,124,847
1926	824,081	1,276,131	7,149	99,058	96,355	578	15,701	1,487,245
1927	828,619	1,167,581	8,650	114,947	89,096	655	16,202	1,387,826
1928	1,028,816	1,340,920	6,907	99,833	87,314	601	13,729	1,541,796
1929	1,036,385	1,060,874	4,979	69,703	71,479	430	11,327	1,213,383

Exports of gypsum in 1929 and 1928 are recorded as follows: "Crude, crushed, or ground," 4,230 short tons, valued at $30,870, in 1929, and 2,365 tons, valued at $23,764, in 1928; "plaster, calcined, and manufactures, n. e. s.," 24,579 short tons, valued at $481,316, in 1929, and 16,423 tons, valued at $392,984, in 1928. For 1927 and earlier years the classification read "Gypsum or plaster, crude, ground, calcined, and manufactures of," and exports were as follows: 1927, 18,429 short tons, valued at $471,106; 1926, 19,610 tons, $576,585; 1925, 16,798 tons, $498,616; 1924, 10,623 tons, $358,425; 1923, 8,815 tons, $226,423; 1922, 7,673 tons, $178,166. Exports are not separately classified for earlier years.

ILMENITE

[See Titanium minerals]

IRON ORE, PIG IRON, AND STEEL

IRON ORE

[Exclusive of all domestic ore containing 5 per cent or more of manganese. For data regarding such ore see Manganese]

Iron ore mined in the United States, 1920–1929, by varieties, in long tons

Year	Hematite	Brown ore	Magnetite	Carbonate	Total
1920	[1] [2] 63,883,523	[2] 1,325,661	[1] 2,391,541	3,740	67,604,465
1921	[1] [2] 28,337,249	[2] 370,154	[1] 780,866	2,709	29,490,978
1922	[2] 44,888,723	[2] 783,582	1,452,966	3,256	47,128,527
1923	[2] 65,924,454	[2] 1,232,848	2,190,624	3,516	69,351,442
1924	[2] 52,102,300	[2] 814,159	1,347,711	3,249	54,267,419
1925	[2] 59,546,690	[2] 884,600	1,472,004	4,703	61,907,997
1926	[2] [3] 64,634,573	[2] 810,924	[3] 2,175,288	2,215	67,623,000
1927	[2] [3] 58,505,543	[2] 743,478	[3] 2,489,586	2,493	61,741,100
1928	[3] 59,207,857	816,637	[3] 2,170,804	1,790	62,197,088
1929	[2] [3] 69,849,231	[2] 775,610	[3] 2,401,104	1,775	73,027,720

[1] Some magnetite included with hematite.
[2] Some hematite included with brown ore.
[3] Some hematite included with magnetite.

Iron ore mined in the United States, 1928 and 1929, by mining districts and varieties, in long tons

District	Hematite	Brown ore	Magnetite	Carbonate	Total
1928					
Lake Superior [1]	52,517,175	----------	----------	----------	52,517,175
Birmingham	5,658,021	509,173	----------	----------	6,167,194
Chattanooga	94,134	98,372	----------	----------	192,506
Adirondack Northern New Jersey and southeastern New York	----------	----------	[2] 963,089	----------	[2] 963,089
Other districts	[2] 938,527	209,092	1,207,715	1,790	[2] 2,357,124
	[2] 59,207,857	816,637	[2] 2,170,804	1,790	62,197,088
1929					
Lake Superior [1]	62,824,768	----------	----------	----------	62,824,768
Birmingham	5,814,143	467,422	----------	----------	6,281,565
Chattanooga	81,524	74,429	----------	----------	155,953
Adirondack	----------	----------	[2] 749,976	----------	[2] 749,976
Northern New Jersey and southeastern New York	----------	----------	353,612	----------	353,612
Other districts	[2] [3] 1,128,796	[3] 233,759	1,297,516	1,775	[2] 2,661,846
	[2] [3] 69,849,231	[3] 775,610	[2] 2,401,104	1,775	73,027,720

[1] Includes only those mines in Wisconsin which are in the true Lake Superior district.
[2] Some hematite from "Other districts" included with magnetite from Adirondack district.
[3] Some hematite included with brown ore.

Iron ore mined in the Lake Superior district, 1920–1929, by ranges, in long tons

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1920	4, 457, 609	5, 651, 542	8, 298, 206	1, 053, 518	36, 641, 880	1, 757, 775	57, 860, 530
1921	2, 204, 114	2, 147, 569	3, 135, 477	981, 576	16, 380, 190	449, 559	25, 298, 485
1922	2, 745, 626	3, 290, 641	4, 910, 789	1, 108, 764	26, 704, 601	955, 595	39, 716, 016
1923	3, 910, 909	4, 913, 541	6, 112, 662	1, 119, 113	41, 809, 018	1, 420, 165	59, 285, 408
1924	3, 579, 087	3, 780, 664	5, 579, 883	1, 141, 690	29, 818, 965	941, 430	44, 841, 719
1925	3, 813, 687	5, 009, 022	6, 377, 710	1, 331, 753	34, 851, 109	673, 382	52, 056, 663
1926	4, 046, 191	5, 445, 683	6, 949, 920	1, 568, 953	37, 997, 797	1, 134, 863	57, 143, 407
1927	4, 015, 730	5, 458, 182	6, 604, 830	1, 577, 817	32, 866, 034	1, 017, 287	51, 539, 880
1928	3, 755, 343	4, 855, 735	6, 342, 092	1, 628, 289	34, 856, 333	1, 079, 383	52, 517, 175
1929	4, 545, 839	5, 428, 469	7, 089, 602	1, 883, 547	42, 371, 192	1, 506, 119	62, 824, 768

Iron ore shipped from mines in the United States, 1920–1929

[Exclusive of ore sold for paint. See p. A64]

Year	Long tons	Value	Year	Long tons	Value
1920	69, 281, 341	$285, 006, 327	1925	63, 924, 763	$160, 796, 886
1921	26, 652, 528	89, 745, 308	1926	69, 292, 832	174, 015, 645
1922	50, 612, 620	157, 809, 286	1927	61, 232, 473	151, 125, 820
1923	69, 811, 472	240, 738, 921	1928	63, 432, 826	155, 788, 657
1924	52, 083, 375	151, 307, 105	1929	75, 602, 734	197, 148, 640

Iron ore shipped from mines in the United States, 1928 and 1929, by States

[Exclusive of ore sold for paint. See p. A64]

State	1928		1929	
	Long tons	Value	Long tons	Value
Alabama	6, 159, 863	$11, 599, 176	6, 637, 299	$12, 575, 113
Colorado	52, 713	(1)	50, 754	(1)
Georgia	73, 052	209, 877	59, 316	175, 145
Michigan	14, 241, 102	37, 039, 644	16, 838, 568	47, 597, 976
Minnesota	38, 129, 018	94, 258, 899	46, 470, 243	121, 776, 312
Missouri	94, 899	377, 847	171, 456	661, 055
Montana	1, 640	5, 900	------	------
New Jersey	350, 616	1, 357, 877	285, 115	1, 157, 848
New Mexico	184, 623	(1)	171, 585	(1)
New York	767, 743	2, 906, 055	875, 564	3, 941, 985
North Carolina	------	------	30, 575	106, 411
Pennsylvania	1, 013, 791	2, 411, 114	1, 151, 130	2, 382, 839
Tennessee	128, 478	286, 524	101, 796	234, 827
Utah	320, 655	(1)	324, 885	(1)
Virginia	27, 970	83, 114	232	631
Washington	1, 012	(1)	5, 018	(1)
Wisconsin	1, 394, 371	3, 700, 797	1, 789, 721	4, 848, 978
Wyoming	491, 280	(1)	639, 477	(1)
Undistributed	------	[2] 1, 551, 833	------	[2] 1, 689, 520
	63, 432, 826	155, 788, 657	75, 602, 734	197, 148, 640

[1] Included under "Undistributed."
[2] This figure covers States entered as "(1)" above.

Stocks of iron ore at mines in the United States, December 31, 1920–1929, in long tons

1920	11, 378, 794	1925	10, 795, 630
1921	13, 836, 267	1926	9, 565, 880
1922	10, 524, 279	1927	10, 104, 673
1923	10, 165, 875	1928	9, 190, 061
1924	12, 410, 619	1929	7, 067, 206

Stocks of iron ore at mines in the United States, December 31, 1928 and 1929, in long tons

State	1928	1929	State	1928	1929
Alabama	996, 751	807, 331	New York	71, 732	24, 164
Iowa	12, 165	12, 165	North Carolina		100
Michigan	5, 556, 372	4, 267, 279	Pennsylvania	93, 611	32, 719
Minnesota	2, 079, 823	1, 713, 426	Virginia	20, 287	20, 055
Missouri	2, 629		Wisconsin	290, 004	127, 794
New Jersey	66, 687	62, 173		9, 190, 061	7, 067, 206

Iron ore imported into and exported from the United States, 1920–1929

Year	Imports		Exports	
	Long tons	Value	Long tons	Value
1920	1, 273, 456	$4, 963, 654	1, 145, 037	$6, 198, 927
1921	315, 768	1, 075, 909	440, 106	2, 077, 620
1922	1, 135, 156	4, 916, 294	602, 194	2, 770, 878
1923	2, 768, 430	11, 308, 503	1, 116, 932	5, 305, 365
1924	2, 047, 055	10, 580, 904	595, 413	2, 407, 003
1925	2, 190, 697	6, 895, 229	630, 521	2, 411, 093
1926	2, 555, 441	5, 876, 316	868, 710	3, 380, 701
1927	2, 620, 717	6, 068, 283	898, 793	3, 425, 435
1928	2, 452, 646	5, 428, 019	1, 282, 306	4, 797, 881
1929	3, 139, 334	8, 145, 354	1, 304, 417	4, 774. 842

PIG IRON

Pig iron shipped from blast furnaces in the United States, 1920–1929

Year	Long tons	Value	Year	Long tons	Value
1920	35, 710, 227	$1, 140, 904, 096	1925	36, 814, 702	$739, 316, 333
1921	16, 038, 619	389, 437, 792	1926	38, 181, 053	749, 633, 468
1922	27, 670, 738	608, 144, 858	1927	34, 866, 644	646, 226, 139
1923	38, 361, 379	946, 799, 378	1928	38, 303, 699	661, 351, 270
1924	31, 064, 129	665, 078, 972	1929	41, 549, 161	731, 858, 075

Pig iron shipped from blast furnaces in the United States, 1928 and 1929, by States

State	1928		1929	
	Long tons	Value	Long tons	Value
Alabama	2, 525, 812	$42, 194, 935	2, 697, 814	$43, 674. 910
Colorado	(1)	(1)	(1)	(1)
Illinois	4, 094, 514	73, 524, 773	4, 316, 096	79, 672, 295
Indiana	3, 842, 762	63, 622, 330	4, 279, 825	71, 416, 732
Kentucky	225, 545	(1)	194, 150	(1)
Maryland	971, 832	(1)	1, 111, 219	(1)
Massachusetts	(1)	(1)	(1)	(1)
Michigan	797, 776	15, 157, 535	841, 089	14, 099, 647
Minnesota	341, 203	(1)	376, 551	(1)
New Jersey			204	(1)
New York	2, 369, 814	39, 928, 960	2, 626, 771	46, 960, 186
Ohio	9, 266, 936	156, 883, 186	9, 446, 984	163, 480, 003
Pennsylvania	12, 289, 455	216, 425, 084	14, 058, 194	257, 154, 601
Tennessee	102, 718	1, 920, 901	104, 985	1, 938, 238
Utah	164, 071	(1)	(1)	(1)
Virginia	63, 175	1, 245, 809	44, 512	(1)
West Virginia	645, 038	(1)	653, 048	(1)
Wisconsin	(1)	(1)		
Undistributed	[2] 603. 048	[2] 50, 447, 757	[2] 797, 719	[2] 53, 461, 463
	38, 303, 699	661, 351, 270	41, 549, 161	731, 858, 075

[1] Included under "Undistributed."

[2] This figure covers States entered as "(1)" above.

Pig iron [1] imported into and exported from the United States, 1920–1929

Year	Imports		Exports	
	Long tons	Value	Long tons	Value
1920 [1]	185,944	$12,801,834	216,828	$10,074,377
1921 [1]	44,036	2,014,926	28,307	933,093
1922	383,445	8,670,860	30,920	756,842
1923	367,778	9,005,077	32,318	862,443
1924	209,109	3,741,213	41,483	957,921
1925	441,425	7,951,283	32,674	724,565
1926	445,773	7,708,982	25,208	523,883
1927	132,568	2,254,355	50,992	1,028,452
1928	140,694	2,232,094	84,682	1,366,794
1929	147,763	2,398,488	46,357	830,225

[1] Figures for 1920 and 1921 include ferro-alloys. Separate data not available prior to 1922.

STEEL

Steel produced in the United States, 1920–1929, in long tons [1]

Year	Bessemer	Open hearth	Crucible	Other steel	Total
1920	8,883,087	32,671,895	72,265	505,687	42,132,934
1921	4,015,938	15,589,802	7,613	170,444	19,783,797
1922	5,919,298	29,308,983	28,606	346,039	35,602,926
1923	8,484,088	35,899,657	44,079	515,872	44,943,696
1924	5,899,590	31,577,350	22,473	432,526	37,931,939
1925	6,723,962	38,034,488	19,562	615,512	45,393,524
1926	6,934,568	40,691,979	15,493	651,723	48,293,763
1927	6,191,727	38,068,335	9,036	666,087	44,935,185
1928	6,620,195	44,113,956	7,769	802,260	51,544,180
1929	7,124,075	48,352,888	5,079	951,431	56,433,473

[1] According to the American Iron and Steel Institute.

LEAD [1]

Refined primary lead produced in the United States from domestic ores, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	476,849	$76,296,000	1925	654,921	$113,956,000
1921	398,222	35,840,000	1926	680,685	108,910,000
1922	468,746	51,562,000	1927	668,320	84,208,000
1923	543,841	76,138,000	1928	626,202	72,639,000
1924	566,407	90,625,000	1929	672,498	84,735,000

[1] For prices of lead, see statement on p. A12.

Refined primary lead produced in the United States, 1925–1929, in short tons

	1925	1926	1927	1928	1929
Domestic ore:					
Desilverized lead	345, 429	366, 413	378, 889	351, 734	381, 487
Soft lead	260, 560	258, 565	233, 944	225, 003	235, 345
Desilverized soft lead	48, 932	55, 707	55, 487	49, 465	55, 666
Total from domestic ore	654, 921	680, 685	668, 320	626, 202	672, 498
Foreign ore:					
Africa		6	12		
Canada	10, 676	5, 385	4, 138	10, 123	9, 499
Central America	6		18	3	
Mexico	31, 107	32, 693	22, 674	14, 839	16, 807
South America	4, 496	9, 893	5, 506	1, 568	3, 285
Other foreign	739	233	21	99	84
Foreign base bullion:					
Mexico	65, 024	70, 046	95, 841	117, 193	51, 295
Peru				11, 044	21, 165
Total from foreign ore and base bullion	112.048	118, 256	128, 210	154, 869	102, 135
Grand total from all sources	766, 969	798, 941	796, 530	781, 071	774, 633
Production of antimonial lead	19, 667	22, 524	24, 347	33, 058	25, 669

Secondary lead recovered in the United States, 1920–1929

Year	Pig lead (short tons)	Lead in alloys (short tons)	Total	
			Short tons	Value
1920	56, 350	68, 300	124, 650	$19, 944, 000
1921	46, 370	57, 410	103, 780	9, 340, 000
1922	75, 480	84, 080	159, 560	17, 552, 000
1923	96, 430	98, 060	194, 490	27, 229, 000
1924	90, 400	114, 100	204, 500	32, 720, 000
1925	112, 420	114, 460	226, 880	39, 477, 100
1926	125, 000	152, 300	277, 300	44, 368, 000
1927	119, 000	157, 000	276, 000	34, 776, 000
1928	138, 000	170, 600	308, 600	35, 797, 600
1929	138, 500	172, 500	311, 000	39, 186, 000

Lead imported for consumption in the United States, 1920–1929, by classes

Year	Lead in ore [1]		Lead in base bullion		Pigs, bars, and old [2]		Sheets, pipe, and shot		Not otherwise specified (value)	Total value
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value		
1920	13, 700, 499	$908, 619	66, 816, 820	$3, 340, 600	68, 901, 959	$3, 887, 821	81, 396	$5, 483	$21, 328	$8, 163, 851
1921	6, 842, 807	327, 046	56, 819, 980	1, 668, 410	61, 909, 094	1, 972, 716	3, 087	140	11, 204	3, 979, 516
1922	23, 649, 851	812, 603	55, 859, 422	1, 815, 142	8, 563, 110	335, 924	6, 018	697	12, 286	2, 976, 652
1923	22, 420, 046	1, 190, 414	11, 124, 151	626, 201	42, 925, 265	2, 510, 466	19, 525	4, 495	90, 027	4, 421, 603
1924	65, 147, 976	3, 145, 791	28, 796, 402	1, 542, 167	27, 362, 392	1, 850, 862	11, 666	4, 384	138, 637	6, 681, 841
1925	12, 706, 508	672, 112	24, 747, 665	1, 823, 566	15, 464, 205	1, 038, 350	27, 579	10, 429	139, 533	3, 683, 990
1926	58, 752, 911	3, 393, 039	13, 341, 038	972, 758	24, 365, 570	2, 191, 658	864, 342	101, 322	62, 895	6, 721, 672
1927	70, 260, 478	4, 203, 897	14, 629, 606	925, 328	9, 933, 679	635, 807	988, 170	104, 890	52, 626	5, 922, 548
1928	46, 511, 508	2, 626, 231	13, 397, 455	560, 983	20, 488, 373	808, 359	775, 329	67, 131	134, 995	4, 197, 699
1929	21, 645, 699	1, 160, 533	12, 395, 696	627, 455	20, 178, 922	1, 052, 087	899, 595	78, 776	126, 966	3, 045, 817

[1] Includes also lead in matte beginning Sept. 22, 1922, when change in tariff went into effect.

[2] Includes also imports of antimonial lead, antimonial scrap lead, babbitt metal, solder, etc., from Sept. 22, 1922, when change in tariff went into effect, through 1924; from 1925 to 1929, inclusive, antimonial lead is excluded.

Lead imported into the United States in ore, base bullion, and refined, by sources, 1925–1929, in pounds

[General imports]

Year	Canada	Mexico	South America	Europe	Other countries	Total
1925	11, 646, 820	218, 873, 800	10, 621, 737	1, 594, 963	1, 521, 110	244, 258, 430
1926	12, 316, 740	254, 203, 852	24, 790, 075	3, 224, 504	572, 856	295, 108, 027
1927	6, 214, 867	300, 634, 815	14, 583, 513	1, 226, 049	118, 883	322, 778, 127
1928	14, 352, 967	275, 184, 287	20, 408, 574	56, 406	85, 915	310, 088, 149
1929	9, 023, 527	175, 872, 302	47, 052, 018	29, 441	141, 480	232, 118, 768

Lead imported into the United States, by classes, 1925–1929, in pounds

[General imports]

Year	Lead in ore	Lead in base bullion	Pigs, bars, sheets, and old	Total lead content
1925	88, 962, 502	141, 253, 559	14, 042, 369	244, 258, 430
1926	116, 232, 669	156, 570, 738	22, 304, 620	295, 108, 027
1927	81, 276, 126	236, 567, 252	4, 934, 749	322, 778, 127
1928	51, 829, 530	256, 935, 461	1, 323, 158	310, 088, 149
1929	62, 661, 371	166, 141, 916	3, 315, 481	232, 118, 768

Lead exported from the United States, 1920–1929, by classes

Year	Pigs and bars				Foreign lead used in articles exported with benefit of drawback[1]	Manufactures of lead from both domestic and foreign ores
	From domestic ore		From foreign ore			
	Pounds	Value	Pounds	Value	Pounds	
1920	5, 459, 713	$462, 223	34, 725, 501	$2, 570, 535	12, 350, 794	$3, 621, 397
1921	3, 247, 294	177, 926	50, 000, 259	2, 284, 107	18, 738, 927	1, 376, 259
1922	11, 645, 821	604, 605	64, 709, 305	3, 177, 360	11, 354, 070	1, 158, 150
1923	3, 997, 485	260, 487	97, 471, 326	5, 195, 256	25, 052, 107	1, 078, 636
1924	10, 664, 083	711, 147	153, 515, 863	9, 685, 619	30, 549, 116	1, 965, 555
1925	9, 910, 955	784, 440	197, 128, 517	14, 910, 891	23, 398, 305	2, 006, 309
1926	8, 551, 639	601, 061	135, 319, 321	8, 904, 603	35, 910, 934	3, 297, 704
1927	5, 066, 035	308, 698	245, 467, 875	12, 508, 566	24, 008, 803	1, 318, 134
1928	28, 403, 279	1, 299, 021	204, 134, 083	9, 060, 200	26, 448, 902	1, 645, 909
1929	38, 515, 061	1, 918, 081	107, 985, 100	5, 260, 256	26, 171, 983	1, 634, 865

[1] Exclusive of lead that entered as pig and was exported in the same form which would be duplicated in exports of lead from foreign ore.

LIME

Lime sold by producers in the United States, 1920–1929

Year	Hydrated			Total		
	Number of plants in operation	Short tons	Value[1]	Number of plants in operation	Short tons	Value[1]
1920	98	853, 116	$9, 287, 562	515	3, 570, 141	$37, 543, 840
1921	105	792, 970	7, 421, 637	520	2, 532, 153	24, 895, 370
1922	114	1, 106, 063	9, 868, 980	530	3, 639, 617	33, 255, 039
1923	121	1, 225, 928	12, 229, 598	467	4, 076, 243	39, 993, 652
1924	120	1, 316, 664	13, 199, 846	450	4, 072, 000	39, 596, 423
1925	134	1, 560, 848	15, 287, 461	450	4, 580, 823	42, 609, 141
1926	147	1, 606, 811	15, 182, 460	435	4, 560, 398	41, 566, 452
1927	157	1, 596, 906	14, 581, 695	417	4, 414, 932	38, 638, 413
1928	164	1, 612, 818	13, 540, 215	411	4, 458, 412	36, 449, 635
1929	157	1, 550, 771	12, 771, 525	381	4, 269, 768	33, 478, 848

[1] The value given represents the value of bulk lime f. o. b. at point of shipment and does not include cost of barrel or package.

Lime sold by producers in the United States, 1928 and 1929, by States

State	1928			1929		
	Number of plants in operation	Short tons	Value	Number of plants in operation	Short tons	Value
Alabama	11	192,364	$1,407,232	10	209,260	$1,223,623
Arizona	2	36,244	343,167	4	42,971	397,308
Arkansas	5	40,438	339,624	4	33,647	295,816
California	9	60,751	617,472	9	49,753	526,391
Colorado	3	8,114	88,775	4	7,046	76,791
Connecticut	6	48,152	529,936	4	35,180	386,855
Florida	3	4,748	50,086	2	(1)	(1)
Georgia	1	12,890	83,045	1	10,757	77,239
Hawaii	1	6,284	72,092	1	6,384	77,389
Idaho	1	(1)	(1)	1	(1)	(1)
Illinois	8	115,523	1,017,001	8	119,382	973,312
Indiana	8	107,209	734,915	8	116,795	786,814
Iowa	2	(1)	(1)	1	(1)	(1)
Kentucky	2	(1)	(1)	1	(1)	(1)
Maine	4	123,023	1,056,443	4	92,428	772,443
Maryland	11	59,508	440,886	12	54,029	404,674
Massachusetts	8	171,944	2,026,019	7	133,644	1,443,984
Michigan	8	104,917	962,708	6	91,468	844,543
Minnesota	3	(1)	(1)	3	(1)	(1)
Missouri	14	303,014	2,252,420	13	316,579	2,319,886
Montana	2	(1)	(1)	2	(1)	(1)
Nevada	1	(1)	(1)	1	(1)	(1)
New Jersey	2	(1)	(1)	1	1,644	15,618
New Mexico	2	2,002	19,665	2	(1)	(1)
New York	13	93,354	794,301	12	104,614	906,021
North Carolina	1	(1)	(1)	1	(1)	(1)
Ohio	28	1,013,676	8,919,596	27	962,415	7,935,656
Oklahoma	----------	----------	----------	1	(1)	(1)
Oregon	3	2,090	34,372	3	2,486	40,406
Pennsylvania	130	834.050	6,119,036	116	782,915	5,896,752
Porto Rico	15	9,405	147,040	12	10,114	131,887
Rhode Island	1	2,589	36,875	1	1,885	24,464
South Dakota	2	(1)	(1)	2	(1)	(1)
Tennessee	9	183,541	1,238,945	10	172,936	1,036,405
Texas	5	82,325	751,729	6	97,332	838,470
Utah	11	47,662	385,476	10	46,581	365,055
Vermont	8	52,445	485,235	7	53,128	505,246
Virginia	32	174,067	1,208,618	29	153,170	1,061,018
Washington	4	24,529	265,922	4	31,598	324,683
West Virginia	12	279,947	1,788,989	13	308,600	1,865,531
Wisconsin	20	163,965	1,374,749	18	130,902	1,094,388
Undistributed	----------	97,642	857,266	----------	90,125	830,180
	411	4,458,412	36,449,635	381	4,269,768	33,478,848

[1] Included under "Undistributed."

Lime imported into and exported from the United States, 1920–1929

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1920	22,688	$392,137	5,921	$128,296
1921	10,811	234,798	5,192	109,769
1922	14,112	290,845	8,289	116,649
1923	25,407	428,903	11,789	170,289
1924	20,480	377,994	14,905	212,340
1925	15,323	285,599	14,800	218,696
1926	18,702	346,969	12,960	191,768
1927	19,567	356,836	15,478	210,977
1928	18,321	344,296	18,188	245,004
1929	21,501	390,736	17,334	239,440

LITHIUM MINERALS

Lithium minerals produced in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	11,696	$173,002	1925	3,140	$58,500
1921	1,833	33,508	1926	3,700	53,400
1922	2,192	41,300	1927	4,173	59,656
1923	2,310	38,800	1928	4,600	94,750
1924	2,996	62,391	1929	(1)	(1)

[1] Bureau of Mines not at liberty to publish figures.

Imports and exports of lithium minerals are not reported separately.

LITHOGRAPHIC STONE

No domestic production of lithographic stone in the United States has been reported since 1918.

Lithographic stone imported for consumption in the United States, 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	786,119	$63,733	1925	186,971	$20,263
1921	301,546	34,101	1926	248,698	28,201
1922	256,426	28,242	1927	45,398	6,790
1923	225,600	24,861	1928	63,505	9,963
1924	133,674	9,046	1929	74,841	7,788

No exports of lithographic stone are reported.

MAGNESITE

Domestic magnesite (expressed as equivalent crude) sold or treated in the United States, 1920–1929

Year	California		Washington		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	81,782	$1,083,262	221,985	$1,664,888	303,767	$2,748,150
1921	47,904	510,177	-----------	-----------	47,904	510,177
1922	[1] 55,790	[1] 571,745	(1)	(1)	55,790	571,745
1923	73,350	938,600	73,900	165,100	147,250	1,103,700
1924	67,240	901,700	52,860	139,600	120,100	1,041,300
1925	64,600	872,100	56,060	560,600	120,660	1,432,700
1926	53,940	604,130	79,560	596,700	133,500	1,200,830
1927	43,750	507,500	77,740	583,050	121,490	1,090,550
1928	41,300	454,300	85,900	644,250	127,200	1,098,550
1929	[1] 187,660	[1] 1,500,000	(1)	(1)	187,660	1,500,000

[1] Washington included with California. Bureau of Mines not at liberty to publish figures.

Magnesite imported for consumption in the United States, 1920–1929

Year	Crude		Calcined	
	Short tons	Value	Short tons	Value
1920	33,550	$406,204	14,780	$373,165
1921	51,993	525,452	6,788	250,932
1922	73,331	976,283	72,265	1,267,622
1923	5,182	44,081	72,955	1,022,968
1924	6	85	64,785	1,172,403
1925	487	6,382	68,395	1,160,830
1926	608	6,555	90,293	1,438,765
1927	856	8,574	59,261	946,361
1928	762	6,264	62,481	966,183
1929	300	3,179	56,879	877,090

Exports are not separately recorded.

MAGNESIUM

Domestic metallic magnesium (ingots, castings, alloys, ribbon, powder, rods, tubes, sheets, etc.) sold or used by producers in the United States, 1920–1927

Year	Number of producers	Pounds	Value	Year	Number of producers	Pounds	Value
1920	2	123,800	$233,200	1924	2	[1] 128,000	[1] $150,000
1921	1	48,000	86,000	1925	2	245,000	274,400
1922	2	[1] 60,000	[1] 89,000	1926	2	322,650	390,400
1923	2	[1] 125,000	[1] 155,000	1927	2	366,400	441,700

[1] Estimate.

New ingot magnesium produced and sold in the United States, 1928 and 1929

Year	Produced (pounds)	Sold or used by producer	
		Pounds	Value
1928	521,075	530,782	$289,658
1929	1,329,669	908,351	512,313

Magnesium imported for consumption in the United States, 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	29,275	$25,055	1925	8,326	$7,070
1921	39,913	30,592	1926	10,117	4,750
1922	182,939	54,448	1927	7,131	8,402
1923	13,974	11,576	1928	12,039	11,890
1924	8,738	6,561	1929	3,490	6,539

Exports are not separately recorded.

MANGANESE

Manganese and manganiferous ore (exclusive of fluxing ore) shipped from mines in the United States, 1920–1929

Year	Ore containing 35 per cent of manganese or more			Ore containing 10 to 35 per cent of manganese			Ore containing 5 to 10 per cent of manganese		
	Number of shippers	Long tons	Value	Number of shippers	Long tons	Value	Number of shippers	Long tons	Value
1920	56	94,420	$2,396,235	31	357,279	$1,450,518	6	279,687	$644,572
1921	14	13,531	495,097	6	8,439	42,755	3	62,670	147,576
1922	18	13,404	455,160	9	344,674	1,071,780	6	251,614	632,039
1923	36	31,500	874,973	41	319,666	1,158,628	12	1,072,457	3,598,327
1924	39	56,515	1,307,477	55	286,470	929,390	12	587,026	1,713,943
1925	42	98,324	1,857,769	53	267,252	915,316	11	1,153,268	2,799,403
1926	34	46,258	1,228,663	54	364,312	1,179,429	8	835,412	1,934,381
1927	39	44,741	1,151,918	47	148,291	673,921	9	1,310,127	3,270,460
1928	38	46,860	1,214,853	31	90,581	407,289	8	1,085,401	2,645,165
1929	37	60,379	1,612,357	32	78,191	451,843	8	1,110,067	2,822,623

Manganese and manganiferous ore (for fluxing purposes) shipped from mines in the United States, 1920–1929

Year	Ore containing 35 per cent of manganese or more		Ore containing 10 to 35 per cent of manganese		Ore containing 5 to 10 per cent of manganese	
	Long tons	Value	Long tons	Value	Long tons	Value
1920			123,970	$332,615	6,728	$10,093
1921			22,962	[1] 57,000	3,028	[1] 7,800
1922	2,278	$17,341	27,705	[1] 52,000	1,666	[1] 10,600
1923	769	(2)	40,770	[1,2] 134,133	1,004	[1] 2,510
1924	1,833	(2)	24,972	[1,2] 107,215		
1925			25,384	[1] 36,177	2,150	[1] 1,590
1926			17,707	24,679		
1927			1,029	[3] 2,635	2,161	(3)
1928			48	[3] 853	1,602	(3)
1929						

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[1] Partly estimated.

[2] Value for 35 per cent ore included with that for 10–35 per cent ore. Bureau of Mines not at liberty to publish figures.

[3] Value for 5–10 per cent ore included with that for 10–35 per cent ore. Bureau of Mines not at liberty to publish figures.

Manganese and manganiferous ore (exclusive of fluxing ore) shipped from mines in the United States, 1928 and 1929, by States

State	Ore containing 35 per cent of manganese or more			Ore containing 10 to 35 per cent of manganese			Ore containing 5 to 10 per cent of manganese		
	Number of shippers	Long tons	Value	Number of shippers	Long tons	Value	Number of shippers	Long tons	Value
1928									
Alabama	2	(1)	(1)						
Arizona	5	3,507	$35,500	1	214	(1)			
Arkansas	6	3,623	81,862	4	7,136	$43,880			
Colorado				4	18,599	99,823			
Georgia	1	4,727	(1)	8	4,687	41,322			
Idaho	2	(1)	(1)						
Michigan				2	7,943	(1)	1	41,261	(1)
Minnesota				1	3,487	(1)	5	1,025,014	$2,471,582
Montana:									
Metallurgical	3	12,044	(1)	1	11,156	(1)			
Chemical	[2] 2	14,689	(1)						
New Mexico	3	2,627	(1)	2	36,250	(1)	1	19,081	(1)
North Carolina	1	10	(1)						
Tennessee	2	55	(1)	5	718	6,778	1	45	(1)
Utah				1	286	(1)			
Virginia:									
Metallurgical	10	3,071	50,106	2	105	(1)			
Chemical	1	741	(1)						
Undistributed		1,766	1,047,385			215,486			173,583
	38	46,860	1,214,853	31	90,581	407,289	8	1,085,401	2,645,165
1929									
Alabama				3	475	5,854			
Arizona	3	2,655	27,826	1	45	181			
Arkansas	3	4,308	94,396	3	13,774	98,826			
California	4	569	8,099						
Colorado				2	17,770	(1)			
Georgia	2	2,521	(1)	7	5,310	57,432			
Idaho	3	1,326	13,707	1	38	239			
Michigan				1	11,023	43,541	2	38,089	(1)
Minnesota				1	5,421	24,991	5	1,004,420	2,506,081
Montana:									
Metallurgical	3	29,945	(1)	1	15,665	(1)			
Chemical	[2] 2	12,382	(1)						
Nevada				5	2,407	21,462			
New Mexico	3	2,969	50,173				1	67,558	(1)
Tennessee	3	523	12,425	3	241	1,810			
Texas	1	42	(1)						
Utah	2	88	(1)	2	5,942	(1)			
Virginia:									
Metallurgical	7	2,651	52,577	2	80	810			
Chemical	1	400	(1)						
Undistributed			1,353,154			196,697			316,542
	37	60,379	1,612,357	32	78,191	451,843	8	1,110,067	2,822,623

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[1] Included under "Undistributed."

[2] Figure represents mills through which all shipments were made; individual producers not counted.

Manganiferous iron ore shipped from the Cuyuna district, Minnesota, 1920–1929, in long tons

Year	Ore containing 10 to 35 per cent of manganese	Ore containing 5 to 10 per cent of manganese	Year	Ore containing 10 to 35 per cent of manganese	Ore containing 5 to 10 per cent of manganese
1920	293,524	248,913	1925	77,665	741,409
1921	----------	56,530	1926	158,759	799,458
1922	305,093	248,560	1927	6,276	934,599
1923	253,634	499,181	1928	3,487	1,025,014
1924	159,915	361,527	1929	5,421	1,004,420

Manganese ore imported for consumption in the United States, 1920–1929

Year	Long tons		Value	Year	Long tons		Value
	Gross weight	Manganese content			Gross weight	Manganese content	
1920	606,937	(1)	$12,230,922	1925	(1)	[2]277,055	$7,417,582
1921	401,354	(1)	3,365,732	1926	(1)	[2]297,630	9,612,673
1922 Jan. 1–Sept. 21	327,727	(1)	2,695,724	1927	620,212	304,388	9,271,920
1922 Sept. 22–Dec. 31	(1)	[2]18,124	364,247	1928	565,938	269,712	6,827,621
1923	(1)	[2]78,391	1,674,914	1929	660,558	318,310	8,182,874
1924	(1)	[2]224,230	5,305,791				

[1] Not recorded by Bureau of Foreign and Domestic Commerce.

[2] Includes estimate by the Bureau of Mines for manganese content of ore imported from Cuba. The Bureau of Foreign and Domestic Commerce recorded only gross weight of Cuban ore imported, and the figures for such ore were as follows: 1922 (Sept. 22 to Dec. 31), 190 long tons; 1923, 9,062 tons; 1924, 23,065 tons; 1925, 12,745 tons; 1926, 14,112 tons.

No separate record of exports of manganese ore is kept.

MANGANIFEROUS ZINC RESIDUUM

Manganiferous residuum, from zinc roasting in the United States, shipped in 1920–1929, in long tons

1920	133,602	1925	147,937
1921	12,627	1926	179,926
1922	81,333	1927	184,771
1923	132,801	1928	171,107
1924	119,457	1929	168,363

MARLS

Calcareous marl sold by producers in the United States, 1920–1929

Year	Short tons	Value
1920	97, 487	$322, 339
1921	59, 730	195, 743
1922	67, 777	203, 196
1923	99, 410	328, 932
1924	72, 710	225, 383
1925	68, 670	$187, 839
1926	55, 060	146, 094
1927	52, 962	180, 166
1928	61, 034	200, 704
1929	38, 990	130, 866

Greensand marl produced in the United States, 1920–1929

Year	Short tons	Value
1920	(1)	(1)
1921	2, 058	$10, 200
1922	7, 885	56, 800
1923	10, 656	131, 123
1924	14, 055	151, 205
1925	12, 728	$179, 788
1926	12, 681	174, 740
1927	11, 911	168, 683
1928	12, 988	207, 042
1929	13, 266	255, 680

[1] Bureau of Mines not at liberty to publish figures.

No imports or exports of marl are reported.

MERCURY

Mercury produced in the United States, 1920–1929

[Flasks of 76 pounds]

Year	Flasks	Value
1920	13, 216	$1, 066, 807
1921	6, 256	300, 595
1922	6, 291	368, 348
1923	7, 833	521, 302
1924	9, 952	692, 739
1925	9, 053	$762, 616
1926	7, 541	702, 323
1927	11, 128	1, 314, 782
1928	17, 870	2, 207, 003
1929	23, 682	2, 892, 638

Mercury imported into and exported from the United States, 1920–1929

[Flasks of 76 pounds]

Year	Imports for consumption		Exports	
	Flasks	Value	Flasks	Value
1920	13, 982	$971, 510	1, 533	$129, 993
1921	10, 462	457, 993	388	18, 869
1922	16, 697	757, 842	287	15, 910
1923	17, 836	816, 043	314	25, 195
1924	12, 996	566, 820	205	14, 333
1925	20, 580	1, 200, 878	201	15, 930
1926	25, 634	1, 784, 250	114	10, 319
1927	19, 941	1, 780, 134	(1)	(1)
1928	14, 562	1, 437, 153	(1)	(1)
1929	14, 917	1, 513, 197	(1)	(1)

[1] Exports of mercury not separately recorded after 1926.

MICA

Mica sold by producers in the United States, 1920–1929

Year	Uncut sheet mica		Scrap mica		Total	
	Pounds	Value	Short tons	Value	Short tons	Value
1920	1, 683, 480	$546, 972	5, 723	$167, 017	6, 565	$713, 989
1921	741, 845	118, 513	2, 577	56, 849	2, 948	175, 362
1922	1, 077, 968	194, 301	[1] 6, 641	114, 045	[1] 7, 180	308, 346
1923	2, 063, 179	311, 180	[1] 8, 054	129, 695	[1] 9, 086	440, 875
1924	1, 460, 897	212, 035	4, 709	87, 242	5, 439	299, 277
1925	1, 793, 865	321, 962	9, 695	173, 537	10, 592	495, 499
1926	2, 172, 159	400, 184	7, 043	136, 643	8, 129	536, 827
1927	1, 512, 492	212, 482	6, 280	110, 139	7, 036	322, 621
1928	1, 681, 777	230, 956	7, 760	132, 422	8, 601	363, 378
1929	2, 035, 128	286, 321	6, 253	117, 901	7, 271	404, 222

[1] Includes mica derived from mica schist.

Mica imported for consumption in the United States, 1920–1929

Year	Sheet				Ground		Total	
	Unmanufactured		Cut and splittings					
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1920	1, 298, 537	$1, 177, 943	(1)	$2, 011, 434	------------	--------	(1)	$3, 189, 377
1921	328, 444	331, 219	(1)	758, 521	134, 650	$2, 166	(1)	1, 091, 906
1922	385, 653	359, 793	(1)	[2] 966, 315	313, 745	4, 514	(1)	1, 330, 622
1923	1, 044, 366	532, 375	[3] 4, 419, 102	[3] 1, 844, 149	1, 867, 385	28, 324	7, 330, 853	2, 404, 848
1924	671, 793	419, 154	[3] 3, 787, 251	[3] 1, 885, 718	1, 342, 107	22, 034	5, 801, 151	2, 326, 906
1925	604, 550	526, 292	[3] 3, 346, 144	[3] 1, 259, 415	950, 614	13, 120	4, 901, 308	1, 798, 827
1926	818, 381	562, 300	[3] 5, 358, 983	[3] 1, 886, 486	140, 732	2, 048	6, 318, 096	2, 450, 834
1927	776, 307	399, 302	[3] 2, 683, 340	[3] 1, 231, 007	------------	--------	3, 459, 647	1, 630, 309
1928	541, 635	294, 194	[3] 3, 563, 190	[3] 1, 132, 248	150	53	4, 104, 975	1, 426, 495
1929	1, 283, 472	729, 158	[3] 5, 191, 173	[3] 1, 494, 207	1, 020	43	6, 475, 665	2, 223, 408

[1] Quantity not reported.

[2] Includes also value of "built up, washers, and other manufactures" ($20,899) imported Sept. 22 to Dec. 31. Not separately classified prior to change in tariff.

[3] Composed of following: 1923, "Cut mica" 60,135 pounds, $49,268; "splittings" 4,301,727 pounds, $1,730,532; "built up" 30,032 pounds, $37,382; and "washers and other" 27,208 pounds, $26,967; 1924, "Cut mica" 74,534 pounds, $69,018; "splittings" 3,619,229 pounds, $1,681,774; "built up" 18,205 pounds, $41,455; and "washers and other" 75,283 pounds, $93,471; 1925, "Cut mica" 41,284 pounds, $63,466; "splittings" 3,239,554 pounds, $1,113,202; "built up" 14,639 pounds, $16,785; and "washers and other" 50,667 pounds, $65,962; 1926, "Cut mica" 46,662 pounds, $44,621; "splittings" 5,229,858 pounds, $1,750,434; "built up" 15,147 pounds, $15,410; and "washers and other" 67,316 pounds, $76,021; 1927, "Cut mica" 64,075 pounds, $75,469; "splittings" 2,588,253 pounds, $1,123,808; "built up" 8,097 pounds, $9,211; and "washers and other" 22,915 pounds, $22,519; 1928, "Cut mica" 49,555 pounds, $93,964; "splittings" 3,496,353 pounds, $1,025,790; "built up" 4,986 pounds, $4,539; and "washers and other" 12,296 pounds, $7,955; 1929, "Cut mica" 118,224 pounds, $201,632; "splittings" 5,052,848 pounds, $1,277,555; "built up" 13,655 pounds, $9,805; and "washers and other" 6,446 pounds, $5,215.

Value of mica exported from the United States, 1920–1929

1920	$316, 169	1925	$198, 596
1921	153, 990	1926	230, 511
1922	129, 186	1927	207, 263
1923	182, 162	1928	229, 391
1924	169, 741	1929	329, 322

MILLSTONES

[See Abrasive materials]

MINERAL PAINTS

Domestic zinc and lead pigments,[1] made in large part direct from ores in the United States, sold by producers, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	143,244	$24,564,572	1925	199,190	$28,310,631
1921	102,463	14,801,032	1926	184,289	25,896,269
1922	162,815	22,205,400	1927	191,853	25,275,975
1923	163,240	23,660,381	1928	202,363	26,017,743
1924	173,859	25,711,159	1929	204,574	26,211,556

[1] Include sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.

The canvass of natural mineral pigments was discontinued after 1915. Figures covering iron ore sold for paint, 1920 to 1929, follow.

Iron ore sold for paint, by producers, in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	27,382	$112,364	1925	29,704	$140,986
1921	11,624	56,824	1926	23,707	129,541
1922	30,668	166,682	1927	25,023	132,007
1923	27,823	140,306	1928	17,815	83,190
1924	23,106	103,626	1929	15,754	90,352

MINERAL WATERS

Natural mineral waters sold by producers in the United States, 1920–1923[1]

Year	Gallons	Value	Year	Gallons	Value
1920	36,218,260	$4,860,915	1922	38,492,881	$5,498,269
1921	34,781,238	4,876,445	1923	44,430,998	6,493,177

[1] Canvass discontinued after 1923.

Mineral waters (natural and artificial) imported for consumption in the United States, 1920–1929

Year	Gallons	Value	Year	Gallons	Value
1920	527,114	$203,901	1925	794,593	$355,411
1921	524,765	167,101	1926	807,638	360,221
1922	698,751	269,245	1927	1,000,038	500,757
1923	722,657	279,875	1928	804,502	396,006
1924	758,771	323,908	1929	1,031,835	510,911

Large quantities of a few domestic waters are exported, but no figures are available prior to 1922. Exports of natural and artificial mineral waters have been as follows: 1922, 209,219 gallons, valued at $169,473; 1923, 227,831 gallons, $193,248; 1924, 221,203 gallons, $179,418; 1925, 206,754 gallons, $178,828; 1926, 255,860 gallons, $191,798; 1927, 197,978 gallons, $173,145; 1928, 195,191 gallons, $184,231; 1929, 196,275 gallons, $188,793.

MOLYBDENUM

Molybdenum in ore and concentrates, produced in the United States, sold in 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	34,900	$17,207	1925	1,154,050	[2] $961,324
1921	-----	-----	1926	(3)	(3)
1922	-----	-----	1927	2,286,075	1,858,786
1923	22,667	(1)	1928	3,329,214	1,924,600
1924	297,174	(1)	1929	3,904,648	[2] 2,259,000

[1] Value not reported.
[2] Estimate by Bureau of Mines.
[3] Bureau of Mines not at liberty to publish figures.

"Molybdenum ore [1] (steel-hardening)" imported for consumption in the United States, 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	[2] 15,639	$9,707	1925	[3] 1,954	$1,793
1921	[2] 29,783	20,471	1926	[3] 13,397	11,175
1922	[2] 412,221	90,015	1927	[3] 12,541	10,472
1923	[3] 16,671	13,115	1928–1929	-----	-----
1924	[3] 10,379	9,038			

[1] Prior to Sept. 22, 1922, imports recorded as ore; beginning with change in tariff, recorded as molybdenum content of ore.
[2] Recorded as molybdenum ore.
[3] Recorded as molybdenum content of ore.

For imports of ferromolybdenum see under Ferro-alloys.
Exports of ferromolybdenum are not separately classified.

MONAZITE

[See Thorium minerals]

NICKEL

Nickel content of nickel salts and metallic nickel produced in the United States as a by-product in the electrolytic refining of copper, 1920–1929, and from mixed ores in 1920

Year	Short tons	Value	Year	Short tons	Value
1920 [1]	365	$293,250	1925	272	$169,664
1921	111	86,000	1926	323	234,558
1922	208	133,191	1927	860	390,740
1923	100	71,605	1928	522	291,836
1924	191	114,903	1929	340	297,273

[1] Including nickel produced from copper-lead-cobalt-nickel ores mined in Missouri.

Secondary nickel recovered as metal and in nonferrous alloys and salts in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	2,200	$1,733,600	1925	2,300	$1,518,000
1921	945	680,400	1926	3,050	2,135,000
1922	1,512	967,700	1927	3,380	2,366,000
1923	1,550	1,109,800	1928	4,500	3,150,000
1924	2,240	1,227,500	1929	4,350	3,045,000

Value of nickel imported for consumption in the United States, 1920–1929

Year	Nickel, nickel ore and matte, nickel oxide, and alloys of nickel with copper, etc.	Manufactures and nickel sheets and strips	Total
1920	$10,657,523	$200,464	$10,857,987
1921	1,220,347	107,155	1,327,502
1922	3,945,309	110,176	4,055,485
1923	6,602,096	94,832	6,696,928
1924	6,132,984	70,755	6,203,739
1925	7,772,320	98,761	7,871,081
1926	9,409,567	65,166	9,474,733
1927	8,802,075	111,816	8,913,891
1928	14,069,357	294,839	14,364,196
1929	19,098,105	318,154	19,416,259

Nickel imported for consumption in the United States, 1928 and 1929, by classes

Class	1928		1929	
	Pounds	Value	Pounds	Value
Unmanufactured:				
Nickel ore and matte	18,589,032	$1,469,717	28,981,343	$2,122,277
Nickel alloys, pigs, bars, etc	48,995,620	12,346,337	64,561,241	16,480,998
Nickel oxide	1,743,218	252,891	3,265,425	494,633
Nickel silver or German silver	2,803	412	1,910	197
Manufactured:				
Nickel silver or German silver in sheets, strips, and rods	22,750	11,101	12,524	10,776
All other manufactures of nickel		283,738		307,378
		14,364,196		19,416,259

Nickel, nickel oxide, and matte exported from the United States, 1920–1923 [1]

Year	Pounds	Value	Year	Pounds	Value
1920	1,215,232	$574,845	1922	9,317,520	$1,016,091
1921	425,851	103,372	1923 [2]	11,200	626

[1] Not separately classified after 1923.

[2] Nickel oxide and matte only. Separate figures for nickel not available.

Nickel exported from the United States, 1928 and 1929, by classes

Class	1928		1929	
	Pounds	Value	Pounds	Value
Nickel Monel metal and other alloys	2,349,269	$879,939	2,869,686	$1,115,568
Manufactures	(1)	1,160,626	(1)	1,347,391
Nickel silver or German silver in bars, rods, or sheets	1,404,549	364,138	1,044,181	325,992
Nickel salts	(2)	(2)	42,195	6,400

[1] Quantity not recorded.

[2] Not separately recorded.

OILSTONES AND SCYTHESTONES

[See Abrasive materials]

ORE

Crude metallic ores (including tailings, etc.) shipped from or treated at the mine in the United States, 1925–1929, in short tons

[Figures rounded]

Class of ore	1925	1926	1927	1928	1929
Aluminum ore (bauxite)	355,000	439,000	359,000	420,000	410,000
Chromite	120	160	220	740	300
Dry and siliceous (gold and silver) ore	8,995,000	8,743,000	8,550,000	8,095,000	7,671,000
Iron ore [1]	71,557,000	77,550,000	68,561,000	71,036,000	84,675,000
Manganese ore (35 per cent or more Mn) [1]	110,000	52,000	50,000	52,000	68,000
Manganiferous ore (5 to 35 per cent Mn) [1]	1,591,000	1,344,000	1,633,000	1,317,000	1,331,000
Mercury ore	65,000	51,000	(2)	(2)	(2)
Copper ore:					
Western States	45,430,000	49,356,000	48,106,000	53,930,000	59,894,000
Central States	7,037,000	7,642,000	8,046,000	7,362,000	7,598,000
Eastern States	795,000	638,000	674,000	833,000	930,000
	53,262,000	57,636,000	56,826,000	62,125,000	68,422,000
Copper-lead and copper-lead-zinc ore	229,000	282,000	419,000	351,000	259,000
Lead ore:					
Western States	2,271,000	2,024,000	2,005,000	1,687,000	1,592,000
Central States	6,287,000	6,330,000	6,344,000	6,361,000	6,573,000
Eastern States	2,000	4,000			
	8,560,000	8,358,000	8,349,000	8,048,000	8,165,000
Lead-zinc ore:					
Western States	2,704,000	3,461,000	3,135,000	3,583,000	3,497,000
Central States	14,917,000	15,488,000	11,310,000	9,796,000	10,972,000
Eastern States	120,000	144,000	202,000		
	17,741,000	19,093,000	14,647,000	13,379,000	14,469,000
Zinc ore:					
Western States	169,000	215,000	452,000	161,000	494,000
Central States	1,674,000	2,806,000	5,177,000	4,350,000	5,076,000
Eastern States	1,568,000	1,118,000	1,194,000	1,344,000	1,623,000
	3,411,000	4,139,000	6,823,000	5,855,000	7,193,000
Grand total	165,876,000	177,687,000	166,217,000	170,679,000	192,663,000

[1] Exclusive of fluxing ore.

[2] Figures not available.

PEAT

Peat produced in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	73,204	$921,732	1924	55,469	$395,470
1921	30,406	260,119	1925	72,436	452,898
1922	60,680	397,729	1926	61,936	364,413
1923	61,355	376,834	1927–1929	(1)	(1)

[1] No canvass.

Peat moss imported for consumption in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	2,762	$36,201	1925	10,233	$121,719
1921	3,450	22,754	1926	16,669	174,241
1922	4,805	33,034	1927	31,595	326,549
1923	5,973	43,184	1928	40,087	422,275
1924	5,541	47,208	1929	57,531	657,145

PETROLEUM AND PETROLEUM PRODUCTS

CRUDE PETROLEUM

Crude petroleum produced in the United States, 1920–1929

[Barrels of 42 U. S. gallons]

Year	Barrels	Value at wells	Year	Barrels	Value at wells
1920	442,929,000	$1,360,745,000	1925	763,743,000	$1,284,960,000
1921	472,183,000	814,745,000	1926	770,874,000	1,447,760,000
1922	557,531,000	895,111,000	1927	901,129,000	1,172,830,000
1923	732,407,000	978,430,000	1928	901,474,000	1,054,880,000
1924	713,940,000	1,022,683,000	1929	1,007,323,000	1,280,417,000

Crude petroleum produced in the United States, 1928 and 1929, by fields and States

	1928		1929	
	Barrels	Value at wells	Barrels	Value at wells
FIELD				
Appalachian	31,059,000	$82,320,000	33,824,000	$104,490,000
Lima-Indiana	1,670,000	2,630,000	1,547,000	2,660,000
Illinois and southwestern Indiana	7,425,000	11,450,000	7,237,000	11,950,000
Michigan	594,000	920,000	4,528,000	6,140,000
Mid-Continent	553,027,000	634,430,000	583,058,000	728,190,000
Gulf coast	46,689,000	55,270,000	57,106,000	69,080,000
Rocky Mountain [1]	29,199,000	37,860,000	27,489,000	36,540,000
California	231,811,000	230,000,000	292,534,000	321,367,000
Other fields [2]	(1)	(1)	(1)	(1)
	901,474,000	1,054,880,000	1,007,323,000	1,280,417,000
STATE				
Alaska	[3] 6,000	[3] 30,000	[3] 7,000	[3] 30,000
Arkansas	32,096,000	27,450,000	24,917,000	21,890,000
California	231,811,000	230,000,000	292,534,000	321,367,000
Colorado	2,774,000	2,750,000	2,358,000	2,380,000
Illinois	6,462,000	9,980,000	6,319,000	10,430,000
Indiana	1,052,000	1,580,000	981,000	1,610,000
Kansas	38,596,000	52,500,000	42,813,000	62,510,000
Kentucky	7,359,000	11,850,000	7,775,000	13,220,000
Louisiana	21,847,000	25,850,000	20,554,000	25,700,000
Michigan	594,000	920,000	4,528,000	6,140,000
Montana	4,015,000	6,400,000	3,980,000	7,260,000
New Mexico	943,000	1,280,000	1,830,000	2,170,000
New York	2,603,000	8,750,000	3,377,000	13,170,000
Ohio	7,015,000	14,470,000	6,743,000	15,770,000
Oklahoma	249,857,000	347,600,000	255,004,000	364,650,000
Pennsylvania	9,956,000	32,550,000	11,820,000	44,800,000
Tennessee	46,000	70,000	19,000	30,000
Texas	257,320,000	236,300,000	296,876,000	322,520,000
Utah	(3)	(3)	(3)	(3)
West Virginia	5,661,000	17,150,000	5,574,000	20,070,000
Wyoming	21,461,000	27,400,000	19,314,000	24,700,000
	901,474,000	1,054,880,000	1,007,323,000	1,280,417,000

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[1] Production of Alaska included with Rocky Mountain.
[2] Alaska.
[3] Utah included with Alaska.

Stocks of crude petroleum held in the United States on December 31, 1928 and 1929, in barrels

		1928	1929
East of California:			
At refineries, by location of storage—			
East coast—			
Domestic		8,496,000	8,955,000
Foreign		4,306,000	3,989,000
Appalachian		2,183,000	2,953,000
Indiana, Illinois, Kentucky, etc		2,939,000	3,305,000
Oklahoma, Kansas, and Missouri		5,530,000	5,610,000
Texas—			
Inland		2,184,000	2,034,000
Gulf coast—			
Domestic		7,206,000	10,749,000
Foreign		207,000	485,000
Arkansas and inland Louisiana		758,000	1,050,000
Louisiana, Gulf coast—			
Domestic		3,315,000	3,930,000
Foreign		1,359,000	1,499,000
Rocky Mountain		2,046,000	1,636,000
Total at refineries		40,529,000	46,195,000
Pipe-line and tank-farm stocks—			
Domestic petroleum, by field of origin—			
Appalachian—			
New York, Pennsylvania, West Virginia, eastern and central Ohio	gross	5,036,000	4,965,000
	net	4,751,000	4,665,000
Kentucky	gross	913,000	708,000
	net	764,000	574,000
Lima-Indiana	gross	1,344,000	731,000
	net	1,162,000	544,000
Illinois-southwestern Indiana	gross	12,035,000	11,113,000
	net	11,367,000	10,411,000
Mid-Continent—			
Oklahoma, Kansas, north, central, west, and Panhandle Texas	gross	251,849,000	265,102,000
	net	239,345,000	252,322,000
North Louisiana and Arkansas	gross	29,131,000	25,229,000
	net	26,403,000	21,590,000
Gulf coast	gross	18,826,000	20,547,000
	net	18,272,000	20,129,000
Rocky Mountain	gross	25,522,000	24,717,000
	net	25,501,000	24,656,000
Total pipe-line and tank-farm	gross	344,656,000	353,112,000
	net	327,565,000	334,891,000
Foreign crude petroleum held in United States by importers—			
At Atlantic coast stations		49,000	80,000
At Gulf coast stations		210,000	32,000
Total		259,000	112,000
Producers' stocks		6,521,000	6,198,000
Total crude stocks east of California		374,874,000	387,396,000
California		116,973,000	153,455,000
Grand total		491,847,000	540,851,000

Indicated deliveries of crude petroleum (exclusive of California grades) to consumers in the United States, 1928 and 1929, in barrels [1]

	1928	1929
Domestic petroleum (by field of origin):		
Appalachian	32,908,000	34,094,000
Lima-Indiana	1,649,000	2,165,000
Michigan	595,000	4,495,000
Illinois and southwestern Indiana	8,232,000	8,183,000
Mid-Continent	534,951,000	575,649,000
Gulf coast	46,331,000	55,028,000
Rocky Mountain [2]	31,084,000	28,172,000
Deliveries and exports	655,750,000	707,786,000
Exports	13,284,000	18,487,000
Deliveries	642,466,000	689,299,000
Foreign petroleum	79,591,000	79,080,000
	722,057,000	768,379,000

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[1] Indicated deliveries equal production plus imports plus stocks, exclusive of refinery stocks, at beginning of period minus exports and stocks at end of period.

[2] Alaska included with Rocky Mountain.

Crude petroleum imported into and exported from the United States, 1920–1929

Year	Imports for consumption		Exports			
			Domestic petroleum		Foreign petroleum [1]	
	Barrels	Value	Barrels	Value	Barrels	Value
1920	106, 175, 289	$55, 799, 254	8, 044, 907	$28, 990, 444	712, 185	$996, 430
1921	125, 363, 983	66, 547, 379	8, 865, 497	20, 204, 491	74, 136	57, 407
1922	127, 308, 423	70, 383, 309	9, 995, 093	18, 348, 110	167, 724	74, 121
1923	82, 015, 025	53, 882, 259	17, 060, 771	23, 111, 832	324, 607	150, 358
1924	77, 775, 173	73, 841, 507	17, 604, 877	26, 495, 011	367, 662	165, 401
1925	61, 824, 242	75, 406, 956	13, 125, 157	24, 274, 905	209, 950	94, 372
1926	60, 382. 329	79, 307, 877	15, 406, 045	28, 495, 773	1, 353	4, 436
1927	58, 382, 632	78, 609, 117	15, 843, 405	25, 944, 489	241	333
1928	79, 766, 672	90, 472, 376	18, 961, 362	26, 786, 248	995	1, 618
1929	78, 932, 572	79, 943, 429	26, 394, 349	37, 799, 683	9	23

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[1] Exports of refined products and shipments of crude petroleum to Alaska, Hawaii, Porto Rico, and the Philippine Islands are not included.

PETROLEUM PRODUCTS

Crude petroleum run to stills and chief petroleum products produced at refineries in the United States, 1920–1929, in barrels

Year	Crude petroleum run to stills		Chief petroleum products			
	Domestic	Foreign	Gasoline	Kerosene	Gas oil and fuel oil	Lubricants
1920	433, 915, 000		116, 251, 000	55, 240, 000	210, 987, 000	24, 938, 000
1921	443, 363, 000		122, 704, 000	46, 313, 000	230, 091, 000	20, 896, 000
1922	425, 823, 000	74, 883, 000	147, 672, 000	54, 913, 000	254, 910, 000	23, 304, 000
1923	538, 252, 000	42, 986, 000	179, 903, 000	55, 927, 000	287, 481, 000	26, 128, 000
1924	597, 954, 000	45, 765, 000	213, 326, 000	60, 026, 000	320, 476, 000	27, 498, 000
1925	693, 582, 000	41, 338, 000	259, 601, 000	59, 689, 000	364, 991, 000	31, 055, 000
1926	734, 301, 000	44, 963, 000	299, 734, 000	61, 768, 000	365, 195, 000	32, 293, 000
1927	778, 729, 000	50, 106, 000	330, 435, 000	56, 113, 000	393, 066, 000	31, 721, 000
1928	835, 711, 000	77, 584, 000	376, 945, 000	59, 353, 000	427, 237, 000	34, 658, 000
1929	912, 191, 000	75, 517, 000	435, 078, 000	55, 940, 000	448, 949, 000	34, 359, 000

Chief petroleum products imported for consumption in the United States, 1920–1929, in barrels

Year	Gasoline	Kerosene	Gas oil and fuel oil	Lubricants
1920	963, 764	(1)	(1)	(1)
1921	900, 381	(1)	(1)	(1)
1922	1, 479, 349	[2] 3, 487	[2] 2, 947, 102	[2] 43, 057
1923	4, 555, 084	7, 178	12, 286, 260	29, 027
1924	3, 452, 923	9, 942	12, 926, 837	10, 761
1925	3, 812, 790	19, 281	12, 245, 468	37, 475
1926	5, 539, 585	74, 097	14, 432, 175	33, 018
1927	5, 002. 306	55, 435	8, 124, 192	7, 944
1928	4, 197, 708	201, 745	7, 268, 147	12, 654
1929	8, 835, 502	208, 008	20, 545, 498	39, 355

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[1] Not separately classified prior to Sept. 22, 1922.
[2] Figures cover Sept. 22 to Dec. 31, 1922; not separately classified prior to change in tariff.

Chief petroleum products exported from the United States, 1920–1929, in barrels

Year	Gasoline	Kerosene	Gas oil and fuel oil	Lubricants
1920	15, 269, 280	20, 730, 120	19, 704, 625	9, 574, 320
1921	12, 692, 270	17, 832, 693	20, 120, 493	6, 888, 491
1922	13, 787, 191	21, 315, 015	16, 600, 462	7, 889, 516
1923	20, 135, 567	20, 188, 796	29, 252, 245	8, 295, 726
1924	28, 246, 078	21, 817, 890	34, 292, 709	9, 030, 944
1925	30, 637, 804	21, 074, 667	32, 508, 547	9, 596, 484
1926	42, 479, 876	22, 016, 214	34, 516, 390	9, 265, 781
1927	43, 334, 164	19, 352, 102	42, 963, 180	9, 686, 361
1928	51, 751, 754	21, 846, 633	41, 573, 185	10, 933, 160
1929	60, 006, 674	19, 820, 352	35, 714, 784	10, 775, 090

PHOSPHATE ROCK

Phosphate rock sold or used by producers in the United States, 1920–1929

Year	Long tons	Value	Year	Long tons	Value
1920	4, 103, 982	$25, 079, 572	1925	3, 481, 819	$11, 545, 678
1921	2, 064, 025	12, 270, 070	1926	3, 209, 976	10, 893, 800
1922	2, 417, 883	10, 482, 846	1927	3, 170, 699	11, 253, 352
1923	3, 006, 706	11, 576, 049	1928	3, 501, 406	12, 443, 179
1924	2, 867, 789	10, 252, 083	1929	3, 760, 855	13, 153, 259

Phosphate rock imported into and exported from the United States, 1920–1929

Year	Imports for consumption		Exports	
	Long tons	Value	Long tons	Value
1920	63	$2, 090	1, 069, 712	$10, 570, 175
1921	3, 535	43, 960	733, 312	7, 320, 137
1922	5, 890	95, 846	719, 294	5, 858, 167
1923	6, 725	92, 263	827, 551	5, 772, 171
1924	16, 098	181, 515	818, 773	5, 120, 832
1925	2, 735	37, 932	870, 200	5, 677, 763
1926	17, 378	192, 611	748, 963	4, 435, 590
1927	28, 195	292, 871	918, 211	4, 731, 562
1928	45, 812	431, 238	898, 764	4, 453, 101
1929	44, 899	469, 171	1, 142, 746	5, 386, 919

PLATINUM AND ALLIED METALS

Reports received from refiners of crude platinum, gold bullion, and copper indicate that 47,977 troy ounces of refined new metals of the platinum group were recovered in 1929, of which 10,886 ounces are believed to be of domestic origin.

New platinum and allied metals recovered by refiners in the United States, 1920–1929, in troy ounces

Year	Platinum	Palladium	Iridium	Osmiridium	Other	Total
1920	36, 015	4, 309	418	409	393	41, 544
1921	51, 791	2, 686	286	581	1, 026	56, 370
1922	54, 142	1, 943	210	1, 301	122	57, 718
1923	46, 780	1, 934	280	787	16	49, 797
1924	57, 827	6, 065	680	1, 261	174	66, 007
1925	41, 300	7, 358	283	648	54	49, 643
1926	76, 154	6, 437	234	2, 113	43	84, 981
1927	41, 121	3, 879	256	631	163	46, 050
1928	51, 427	5, 148	1, 658	458	348	59, 039
1929	41, 760	5, 295	302	364	256	47, 977

Dealers and refiners reported recovery in 1929 of 42,759 ounces of secondary platinum metals derived from refining scrap metal, sweeps, and other waste products of manufacture that contain platinum. Although the figures that make up this total undoubtedly contain some duplication, it is believed that they are worth publishing.

Secondary platinum and allied metals recovered in the United States, 1920–1929, in troy ounces

Year	Platinum	Palladium	Iridium	Other	Total
1920	51, 255	3, 100	3, 355		57, 710
1921	39, 131	4, 887	1, 776	229	46, 023
1922	40, 062	4, 193	1, 937	496	46, 688
1923	39. 152	6, 246	2, 021	453	47, 872
1924	45, 474	5, 784	2, 200	1, 013	54, 471
1925	35, 578	4, 680	1, 827	1, 189	43, 274
1926	38, 795	5, 647	1, 478	217	46, 137
1927	46, 127	4, 244	1, 810	891	53, 072
1928	47, 157	4, 156	2, 090	2, 428	55, 831
1929	33, 638	5, 120	2, 057	1, 944	42, 759

Platinum and allied metals imported for consumption in the United States, 1920–1929

Year	Troy ounces	Value	Year	Troy ounces	Value
1920	100, 546	$10, 617, 440	1925	125, 802	$13, 230, 148
1921	78, 378	5, 418, 464	1926	134, 797	13, 451, 835
1922	110, 025	8, 983, 547	1927	148, 769	12, 413, 494
1923	106, 637	10, 466, 705	1928	135, 233	9, 357, 737
1924	111, 359	11, 030, 349	1929	155, 075	9, 119, 479

Platinum and allied metals imported for consumption in the United States, 1928 and 1929, by metals

Metal	1928		1929	
	Troy ounces	Value	Troy ounces	Value
Platinum:				
Ores of platinum metals (platinum content)	686	$49, 094	564	$43, 152
Grains, nuggets, sponge, or scrap	78, 399	5, 298, 665	74, 063	4, 466, 149
Ingots, bars, sheets or plates, not less than one-eighth inch thick	29, 362	2, 348, 840	40, 594	2, 640, 097
	108, 447	7, 696, 599	115, 221	7, 149, 398
Manufactures of, except jewelry	39	3, 146	2	697
Iridium	4, 212	672, 384	4, 470	887, 893
Osmiridium	5, 785	418, 829	6, 863	391, 025
Osmium	310	20, 337	1, 124	70, 515
Palladium	13, 463	407, 826	24, 364	532, 285
Rhodium	1, 887	102, 120	2, 073	61, 849
Ruthenium	1, 090	36, 496	958	25, 817
	135, 233	9, 357, 737	155, 075	9, 119, 479

Platinum exported from the United States, 1920–1929

Year	Unmanufactured		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
1920	1, 302	$177, 115	(1)	$111, 014
1921	3, 272	244, 473	741	85, 216
1922 Crude, scrap, and old	143	13, 149	486	35, 967
1922 Ingots, sheets, wire, and alloys	1, 313	127, 047		
1923	1, 151	128, 599	592	65, 073
1924	5, 854	643, 282	1, 274	136, 948
1925	16, 234	1, 787, 122	3, 537	249, 975
1926	11, 573	1, 253, 795	1, 898	160, 648
1927	19, 923	1, 577, 560	1, 549	128, 875
1928	9, 050	619, 478	2, 168	160, 554
1929	2, 567	193, 122	1, 455	112, 252

[1] Quantity not recorded.

POTASH

Crude potassium salts produced and sold in the United States, 1920–1929

Year	Produced			Sold		
	Number of plants	Gross weight (short tons)	Equivalent as K_2O (short tons)	Gross weight (short tons)	Equivalent as K_2O (short tons)	Value f. o. b. plant
1920	66	166, 834	48, 077	139, 963	41, 444	$7, 463, 026
1921	20	25, 485	10, 171	10, 337	4, 408	447, 859
1922	12	25, 176	11, 714	22, 028	11, 313	463, 512
1923	12	39, 029	20, 215	35, 164	19, 281	784, 671
1924	12	43, 734	22, 903	37, 492	21, 880	842, 618
1925	9	51, 565	25, 448	52, 823	25, 802	1, 204, 024
1926	7	46, 324	23, 366	51, 369	25, 060	1, 083, 064
1927	9	76, 819	43, 510	94, 722	49, 500	2, 448, 146
1928	9	104, 129	59, 910	105, 208	60, 370	3, 029, 422
1929	5	107, 820	61, 590	101, 370	57, 540	2, 988, 448

Potash materials imported for consumption in the United States, 1920–1929

Year	Potassium salts used mainly in the fertilizer industry [1]			Potassium salts used mainly in chemical industries [2]			Total		
	Short tons		Value	Short tons		Value	Short tons		Value
	Gross weight	Equivalent as K_2O (approximate)		Gross weight	Equivalent as K_2O (approximate)		Gross weight	Equivalent as K_2O (approximate)	
1920	918, 698	197, 795	$33, 885, 627	63, 564	26, 997	$9, 504, 156	982, 262	224, 792	$43, 389, 783
1921	212, 752	64, 126	7, 743, 364	32, 453	14, 572	3, 739, 090	245, 205	78, 698	11, 482, 454
1922	632, 711	186, 264	10, 951, 197	34, 198	15, 151	4, 415, 891	666, 909	201, 415	15, 367, 088
1923	712, 701	194, 210	10, 633, 475	35, 824	15, 740	4, 771, 097	748, 525	209, 950	15, 404, 572
1924	663, 914	187, 079	10, 042, 575	28, 336	13, 286	3, 325, 552	692, 250	200, 365	13, 368, 127
1925	892, 684	239, 167	12, 730, 019	44, 429	19, 050	4, 641, 747	937, 113	258, 217	17, 371, 766
1926	859, 422	245, 700	13, 635, 154	47, 941	20, 580	4, 796, 711	907, 363	266, 280	18, 431, 865
1927	687, 349	225, 000	13, 178, 610	43, 248	19, 155	5, 191, 195	730, 597	244, 155	18, 369, 805
1928	931, 616	310, 000	18, 227, 830	44, 045	20, 493	4, 292, 162	975, 661	330, 493	22, 519, 992
1929	870, 502	297, 000	17, 629, 535	58, 968	27, 638	6, 043, 106	929, 470	324, 638	23, 672, 641

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[1] Includes kainite, manure salts, muriate, and sulphate. Considerable quantities of muriate and some sulphate were used in chemical industries.

[2] Includes bicarbonate, bichromate, bitartrate, bromide, carbonate, caustic, chlorate, chromate, cyanide, ferricyanide, ferrocyanide, iodide, nitrate, perchlorate, permanganate, and Rochelle salt.

Domestic potassium salts exported from the United States, 1920–1929

Year	Gross weight (short tons)	Value	Year	Gross weight (short tons)	Value
1920	(1)	$3,562,015	1925	2,155	$398,740
1921	(1)	335,993	1926	1,679	319,201
1922	6,238	780,996	1927	1,965	487,726
1923	3,997	505,837	1928	2,619	609,018
1924	1,923	301,036	1929	1,523	583,668

[1] Figures not available.

PUMICE

[See Abrasive materials]

PYRITES

Pyrites produced in the United States, 1920–1929

Year	Long tons	Value	Year	Long tons	Value
1920	310,777	$1,596,961	1925	170,081	$650,448
1921	157,118	711,432	1926	166,559	616,668
1922	169,043	671,241	1927	215,786	804,006
1923	181,628	661,000	1928 [1]	312,815	1,081,758
1924	160,096	645,262	1929 [1]	333,465	1,250,141

[1] Figures for 1928 and 1929 include pyrites concentrates from Tennessee and partly desulphurized tailings from zinc operations in Wisconsin; similar output in earlier years not included in the statistics.

Pyrites containing more than 25 per cent of sulphur imported for consumption in the United States, 1920–1929

Year	Long tons	Value	Year	Long tons	Value
1920	332,606	$1,660,832	1925	276,385	$773,925
1921	216,229	818,852	1926	366,151	856,981
1922	279,445	1,199,076	1927	250,794	647,512
1923	263,695	1,254,389	1928	457,123	1,135,463
1924	246,737	598,544	1929	514,336	1,507,648

Exports of "pyrites or other sulphur ore" in 1922 amounted to 323 long tons, valued at $4,325. Data for other years are not separately shown.

QUARTZ

[See under Silica]

QUICKSILVER

[See Mercury]

RADIUM

[See Uranium and vanadium ores]

RUTILE

[See Titanium minerals]

SALT

Salt sold or used by producers in the United States, 1920–1929

Year	Short tons				Total value
	Manufactured (evaporated)	In brine	Rock salt	Total	
1920	2,409,924	2,819,916	1,610,189	6,840,029	$29,894,075
1921	1,931,243	1,577,335	1,472,576	4,981,154	24,557.966
1922	2,276,683	2,569,042	1,947,124	6,792,849	27,464,838
1923	2,239,872	2,787,239	2,103,602	7,130,713	27,795,941
1924	2,224,555	2,513,853	2,064,707	6,803,115	25,747,048
1925	2,235,170	2,819,690	2,342,640	7,397,500	26,162,361
1926	2,198,060	3,037,820	2,135,720	7,371,600	25,055,012
1927	2,263,030	3,161,800	2,143,860	7,568,690	24,817,962
1928	2,430,050	3,426,870	2,217,780	8,074,700	26,772,568
1929	2,546,390	3,884,160	2,113,010	8,543,560	27,334,695

Salt sold or used by producers in the United States, 1928 and 1929, by States

State	1928		1929	
	Short tons	Value	Short tons	Value
California	383,730	$2,292,296	410,300	$2,432,329
Kansas	821,950	3,573,982	840,370	3,761,984
Louisiana	630,780	2,405,351	525,840	2,277,366
Michigan	2,405,240	8,249,437	2,650,220	8,343,607
New York	2,085,230	6,400,933	2,194,590	6,470,051
Ohio	1,308,110	2,988,862	1,449,360	3,199,903
Utah	85,800	193,582	84,940	202,676
West Virginia	18,700	149,421	20,290	153,477
Undistributed [1]	335,160	518,704	367,650	493,302
	8,074,700	26,772,568	8,543,560	27,334,695

[1] 1928: Arizona, Nevada, New Mexico, Oklahoma, Texas, and Virginia; 1929: Nevada, New Mexico, Oklahoma, Porto Rico, Texas, and Virginia.

Salt imported into and exported from the United States, 1920–1929

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1920	137,654	$676,499	139,272	$1,901,593
1921	93,095	531,031	109,563	1,415,471
1922	113,922	522,338	134,989	1,429,172
1923	88,750	383,258	125,529	1,211,226
1924	88,938	324,092	144,945	1,288,376
1925	85,788	316,827	155,079	1,219,935
1926	55,964	202,243	158,908	1,277,790
1927	44,968	167,675	153,832	1,329,980
1928	42,856	149,559	145,396	1,185,682
1929	36,450	131,716	109,222	1,008,842

SAND AND GRAVEL

Sand and gravel sold or used by producers in the United States, 1920–1929

Year	Glass sand		Molding sand		Building sand	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	2, 165, 926	$4, 748, 690	5, 128, 075	$7, 504, 759	26, 539, 365	$17, 956, 635
1921	1, 280, 359	2, 314, 314	1, 906, 977	2, 451, 966	24, 565, 605	16, 053, 413
1922	1, 768, 549	2, 866, 366	3, 839, 116	4, 478, 405	29, 375, 466	17, 574, 579
1923	2, 034, 958	3, 751, 778	5, 559, 644	6, 730, 417	39, 234, 762	23, 751, 244
1924	2, 169, 899	3, 718, 973	4, 403, 893	4, 995, 268	41, 376, 425	23, 455, 393
1925	2, 334, 921	3, 836, 085	4, 995, 428	5, 400, 618	45, 287, 240	26, 306, 463
1926	2, 274, 218	3, 615, 371	5, 309, 166	5, 630, 799	45, 327, 512	24, 891, 475
1927	2, 171, 693	3, 257, 790	4, 194, 975	4, 458, 508	40, 737, 377	22, 198, 767
1928	2, 310, 828	3, 435, 645	4, 781, 765	5, 089, 969	45, 629, 207	24, 116, 772
1929	2, 219, 677	3, 788, 471	6, 195, 343	6, 410, 343	41, 161, 013	23, 309, 238

Year	Other sand		Gravel		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	9, 942, 776	$8, 988, 530	38, 265, 246	$26, 462, 991	82, 041, 388	$65, 661, 605
1921	10, 542, 013	8, 230, 257	41, 550, 054	27, 434, 295	79, 845, 008	56, 484, 245
1922	14, 711, 792	10, 550, 570	45, 172, 123	29, 147, 744	94, 867, 046	64, 617, 664
1923	20, 535, 907	14, 240, 126	72, 566, 882	42, 430, 089	139, 932, 153	90, 903, 654
1924	27, 621, 793	16, 674, 831	80, 658, 053	48, 168, 650	156, 230, 063	97, 013, 115
1925	34, 564, 633	19, 605, 159	84, 819, 251	52, 393, 798	172, 001, 473	107, 542, 123
1926	39, 203, 383	21, 538, 343	90, 986, 539	55, 662, 713	183, 100, 818	111, 338, 701
1927	46, 484, 294	24, 376, 333	103, 865, 930	61, 238, 388	197, 454, 269	115, 529, 786
1928	45, 015, 917	23, 490, 020	111, 381, 151	63, 075, 531	209, 118, 868	119, 207, 937
1929	49, 677, 021	27, 293, 305	123, 318, 851	72, 034, 622	222, 571, 905	132, 835, 979

Sand and gravel imported into and exported from the United States, 1920–1929

Year	Imports for consumption		Exports	
	Short tons	Value	Short tons	Value
1920	1, 226, 684	$912, 282	(1)	$669, 945
1921	906, 905	771, 734	(1)	379, 982
1922	[2] 451, 943	[2] 238, 386	356, 520	400, 199
1923	[3] 477, 762	[3] 259, 820	551, 233	598, 633
1924	[3] 701, 410	[3] 280, 206	314, 140	401, 662
1925	[3] 534, 555	[3] 233, 422	425, 612	496, 050
1926	[3] 947, 579	[3] 341, 911	424, 374	610, 023
1927	[3] 736, 271	[3] 302, 551	421, 243	557, 644
1928	[3] 788, 222	[3] 392, 111	737, 368	638, 288
1929	[3] 1, 666, 387	[3] 751, 602	486, 378	809, 831

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[1] Quantities not recorded prior to 1922.

[2] Includes 65,848 tons of gravel, valued at $27,434, and 1,290 tons of glass sand, valued at $1,112, imported after change in tariff Sept. 22. Not separately shown prior to that time.

[3] Includes: 1923, 198,960 tons of gravel, valued at $99,687, and 2,309 tons of glass sand, valued at $3,008; 1924, 448,586 tons, $155,146, and 6,479 tons, $1,961; 1925, 224,600 tons, $89,505, and 4,186 tons, $2,262: 1926, 239,476 tons, $90,226, and 8,817 tons, $9,091; 1927, 313,809 tons, $104,312, and 10,665 tons, $8,712; and 1928, 359,237 tons, $167,350, and 43,137 tons, $35,689, respectively. In 1929, includes 559,413 tons of gravel, valued at $305,343, but no glass sand.

SAND-LIME BRICK

Sand-lime brick sold in the United States, 1920–1929 [1]

Year	Number of operators	Thousands	Value	Year	Number of operators	Thousands	Value
1920	37	169,761	$2,490,283	1925 [2]	42	315,595	$3,780,639
1921 [2]	26	97,126	1,268,502	1926 [2]	42	330,586	3,981,492
1922	(1)	(1)	(1)	1927 [2]	47	319,618	3,645,842
1923 [2]	33	213,425	2,471,536	1928 [2]	41	313,553	3,654,590
1924 [2]	37	283,417	3,334,503	1929 [2]	40	269,584	2,909,635

[1] Canvass discontinued by U. S. Geological Survey after 1920. No canvass for 1922.
[2] According to Bureau of the Census. Figures represent production.

Imports of sand-lime brick were not reported separately until 1924. The figures for 1924 are 22,426,000 brick, valued at $129,042; for 1925, 148,000 brick, $1,004; for 1926, 3,095,000 brick, $28,748; for 1927, none; for 1928, 1,707,000 brick, $8,628; and for 1929, 675,000 brick, $6,583.

Exports are not reported separately.

SELENIUM

Most of the selenium produced is a by-product in the electrolytic refining of copper.

Selenium, produced in the United States, sold in 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	92,141	$175,508	1925	194,007	$330,637
1921	55,978	89,148	1926	252,312	438,132
1922	123,565	177,542	1927	284,508	491,996
1923	127,174	237,196	1928	362,697	607,382
1924	153,762	286,066	1929	344,288	568,265

Selenium and selenium salts imported for consumption in the United States, 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	------	------	1925	5,807	$10,582
1921	1,106	$2,099	1926	18,885	34,680
1922	1,652	2,530	1927	15,286	28,199
1923	940	1,653	1928	18,622	33,998
1924	300	606	1929	3,592	5,971

Exports of selenium are not separately recorded.

SILICA

Quartz sold or used by producers in the United States, 1920–1929

Year	Crude		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	59, 423	$142, 397	8, 767	$177, 953	68, 190	$320, 350
1921	8, 570	39, 660	2, 682	45, 297	11, 252	84, 957
1922	5, 085	23, 093	5, 568	78, 254	10, 653	101, 347
1923	14, 159	66, 723	6, 442	126, 907	20, 601	193, 630
1924	20, 570	123, 099	3, 191	80, 078	23, 761	203, 177
1925	22, 312	143, 861	3, 132	61, 515	25, 444	205, 376
1926	22, 230	159, 052	5, 513	115, 281	27, 743	274, 333
1927	18, 504	124, 021	3, 640	70, 019	22, 144	194, 040
1928	15, 363	79, 229	6, 835	130, 104	22, 198	209, 333
1929	13, 104	59, 257	7, 877	146, 502	20, 981	205, 759

Silica sold or used by producers in the United States for pottery, paints, fillers, polishers, abrasives, and other uses, 1928 and 1929

Material	1928		1929	
	Short tons	Value	Short tons	Value
Quartz (vein quartz, pegmatite, and quartzite)	22, 198	$209, 333	20, 981	$205, 759
Sand and sandstone [1]	280, 402	1, 966, 296	302, 139	2, 039, 144
Tripoli (including rottenstone) (ground and otherwise prepared)	34, 043	555, 576	38, 011	545, 658
Diatomite	(2)	(2)	(2)	(2)
	(2)	(2)	(2)	(2)

[1] Includes only finely ground material. Figures probably incomplete.

[2] Bureau of Mines not at liberty to publish figures for diatomite.

Imports of "crude silica" have been as follows: 1929 and 1928, none; 1927, 12 short tons, valued at $175; 1926, 27 tons, $149; 1925, 22 tons, $486; 1924, 12 tons, $254; and 1923, 34 tons, $550. Similar imports were not recorded prior to September 22, 1922, but from that date to the end of the year 1 ton, valued at $45, was imported. Imports of "silica for use as pigment" have been recorded as follows: 1929 and 1928, none; 1927, 22 short tons, valued at $535; similar imports not separately recorded for earlier years. The Bureau of Foreign and Domestic Commerce records imports of "flint, flints, and flint stones, unground," from several countries. These imports are partly flint pebbles for use in grinding mills and partly material for uses such as are listed above. The figures can not be accurately separated.

"Flint, flints, and flint stones, unground" imported for consumption in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	26, 636	$338, 630	1925	16, 240	$105, 041
1921	10, 084	116, 157	1926	15, 091	120, 078
1922	16, 040	145, 805	1927	15, 191	93, 658
1923	15, 952	130, 974	1928	15, 719	144, 313
1924	17, 473	114, 958	1929	14, 097	127, 457

No exports of silica are reported.

SILVER

[See under Gold and silver]

SLATE

Slate sold by producers in the United States, 1920–1929, by uses

Year	Roofing slate		Mill stock		Slate for other uses [1]	Total value
	Number of squares (100 square feet)	Value	Square feet	Value		
1920	396, 230	$3, 524, 658	9, 910, 000	$3, 147, 281	$2, 054, 503	$8, 726, 442
1921	348, 085	3, 197, 745	8, 970, 000	2, 719, 723	1, 404, 538	7, 322, 006
1922	479, 243	4, 069, 761	9, 276, 800	2, 899, 195	2, 207, 828	9, 176, 784
1923	507, 587	4, 582, 535	11, 109, 480	4, 159, 644	3, 334, 445	12, 076, 624
1924	469, 393	4, 626, 614	10, 009, 180	3, 922, 366	3, 227, 036	11, 776, 016
1925	494, 530	5, 084, 945	11, 077, 860	4, 231, 477	3, 258, 904	12, 575, 326
1926	465, 900	5, 079, 087	10, 278, 130	4, 191, 185	3, 082, 495	12, 352, 767
1927	468, 560	4, 949, 940	9, 287, 680	3, 519, 386	2, 911, 410	11, 380, 736
1928	483, 280	5, 411, 332	9, 220, 170	3, 408, 304	2, 652, 655	11, 472, 291
1929	462, 120	4, 920, 766	9, 936, 480	3, 702, 145	2, 622, 267	11, 245, 178

[1] Chiefly slate granules.

Value of slate sold by producers in the United States, 1925–1929, by States

State	1925	1926	1927	1928	1929
California		$2, 976	(1)	(1)	(1)
Maine	$604, 062	662, 184	$549, 952	$551, 242	$653, 627
Maryland	210, 148	207, 989	205, 812	187, 830	214, 770
New York	851, 715	913, 814	802, 437	1, 052, 363	838, 531
Pennsylvania	5, 885, 179	5, 413, 177	4, 769, 432	4, 786, 355	4, 798, 200
Vermont	3, 963, 025	4, 267, 041	4, 108, 911	3, 981, 928	3, 704, 894
Virginia	[2] 377, 082	[2] 331, 651	[2] 398, 612	[2] 458, 153	[2] 434, 628
Undistributed [3]	[4] 684, 115	[4] 553, 935	[4] 545, 580	[4] 454, 420	[4] 600, 528
	12, 575, 326	12, 352, 767	11, 380, 736	11, 472, 291	11, 245, 178

[1] Included under "Undistributed."

[2] Exclusive of value of granules, etc., which is included under "Undistributed."

[3] 1925: Georgia, Tennessee, and Utah; 1926: Arkansas, Georgia, and Tennessee; 1927: California, Georgia, and Tennessee; 1928: Arkansas, California, Georgia, and Tennessee; 1929: Arkansas, California, Georgia, and New Jersey.

[4] Includes also value of granules, etc., for Virginia.

Slate sold by producers in the United States, 1928 and 1929, by uses

Use	1928		1929	
	Quantity	Value	Quantity	Value
Roofing squares	483, 280	$5, 411, 332	462, 120	$4, 920, 766
Approximate equivalent in short tons	177, 310		178, 500	
Electrical square feet	1, 289, 060	1, 025, 386	1, 461, 110	1, 153, 396
Approximate equivalent in short tons	10, 990		12, 580	
Structural and sanitary square feet	2, 543, 470	1, 034, 818	3, 286, 550	1, 287, 150
Approximate equivalent in short tons	19, 990		24, 730	
Grave vaults and covers square feet	532, 570	136, 836	515, 450	133, 031
Approximate equivalent in short tons	5, 060		4, 700	
Blackboards and bulletin boards square feet	3, 713, 840	1, 079, 452	3, 562, 360	1, 042, 771
Approximate equivalent in short tons	9, 450		9, 280	
Billiard table tops square feet	293, 360	109, 221	161, 470	65, 426
Approximate equivalent in short tons	2, 550		1, 390	
School slates pieces	1, 584, 820	22, 591	1, 843, 000	20, 371
Approximate equivalent in square feet	847, 870		949, 540	
Approximate equivalent in short tons	740		1, 030	
Flagstones, walk ways, etc square feet	932, 110	184, 184	1, 248, 190	124, 524
Approximate equivalent in short tons	6, 290		8, 920	
Granules and "flour" short tons	413, 980	2, 468, 471	428, 940	2, 497, 743
Total (quantities approximate, in short tons)	646, 360	11, 472, 291	670, 070	11, 245, 178

Value of slate imported for consumption in the United States, 1920–1929

1920	$4, 512	1925	$64, 570
1921	2, 923	1926	86, 681
1922	2, 753	1927	78, 909
1923	16, 881	1928	44, 778
1924	32, 095	1929	95, 073

Value of roofing slate exported from the United States, 1920–1929

1920	$122, 105	1925	$54, 130
1921	101, 630	1926	53, 117
1922	97, 811	1927	80, 171
1923	78, 780	1928	119, 187
1924	77, 422	1929	121, 367

The following figures for exports of slate other than roofing were collected by the Bureau of Mines from shippers of the products named.

Slate other than roofing exported from the United States, 1927–1929, by uses

Use	1927		1928		1929	
	Quantity	Value	Quantity	Value	Quantity	Value
School slates, cases[1]	8, 060	$76, 333	14, 320	$81, 075	19, 570	$108, 135
Electrical slate, square feet	25, 550	26, 916	23, 190	19, 102	16, 720	18, 037
Blackboards, do	142, 650	50, 120	160, 680	63, 526	188, 720	74, 610
Billiard tables, do	55, 350	37, 341	65, 620	45, 010	20, 150	34, 455
Structural, do	13, 200	9, 100	14, 440	7, 741	18, 390	15, 882
Slate granules, short tons	11, 360	67, 000	13, 990	82, 140	14, 250	84, 185
	----------	266, 810	----------	298, 594	----------	335, 304

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[1] Cases weigh from 130 to 165 pounds each; average is 135 pounds.

SOAPSTONE

[See Talc and soapstone]

SODIUM SALTS (NATURAL)

In addition to common salt, figures for which are given on page A75, the following quantities of other natural sodium salts (including carbonate, bicarbonate, sulphate, trona, and borate) and colemanite have been shipped by the producers.

Sodium salts (other than NaCl), derived from natural sources in the United States, shipped by producers, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	42, 683	$1, 513, 179	1925	73, 300	$2, 095, 110
1921	25, 000	894, 000	1926	93, 480	2, 326, 750
1922	45, 406	1, 415, 774	1927	145, 770	3, 834, 324
1923	59, 440	1, 775, 940	1928	206, 380	5, 272, 228
1924	76, 420	1, 825, 850	1929	275, 190	6, 107, 666

Borates (colemanite and naturally occurring sodium borates) shipped by producers in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	120,320	$2,173,000	1925	113,700	$3,085,660
1921	50,000	1,600,000	1926	115,970	3,128,110
1922	85,220	2,705,140	1927	109,080	3,473,399
1923	136,650	3,994,790	1928	131,000	3,999,773
1924	116,110	3,183,910	1929	169,870	4,515,375

STEEL

[See Iron ore, pig iron, and steel]

STONE

Stone sold or used by producers in the United States, 1920–1929, by varieties

Year	Granite		Basalt and related rocks (trap rock)		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1920	4,760,000	$24,954,908	9,219,200	$12,260,148	431,500	$11,069,585	59,290,000	$75,655,260
1921	4,752,180	20,592,217	8,524,480	11,450,899	315,400	8,580,416	45,621,000	57,749,594
1922	5,913,120	21,125,869	10,032,900	12,600,611	427,870	10,534,671	58,928,660	68,397,927
1923	7,300,130	29,704,796	10,674,470	13,539,648	562,560	12,863,974	76,701,360	89,620,007
1924	6,883,860	28,772,161	11,671,500	14,679,523	516,000	13,302,235	75,894,430	89,868,956
1925	8,074,200	30,531,347	11,842,110	14,770,042	564,150	13,882,457	85,649,440	98,008,028
1926	9,330,390	32,044,523	12,977,740	15,950,302	563,170	14,167,480	91,887,900	109,252,299
1927	10,706,740	35,287,206	13,210,570	17,399,949	600,060	15,625,872	99,662,270	112,439,824
1928	9,556,500	33,994,527	15,327,760	19,693,945	579,490	16,402,986	96,864,650	110,231,974
1929	10,826,730	34,225,110	14,871,780	18,946,197	553,660	16,545,312	100,686,960	113,906,071

Year	Sandstone		Other stone [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	3,343,000	$7,310,290	1,483,300	$2,291,769	78,527,000	$133,541,960
1921	2,640,460	6,425,339	1,685,220	2,163,801	63,538,740	106,962,266
1922	3,388,130	7,521,044	1,520,880	1,886,806	80,211,560	122,066,928
1923	4,349,270	9,174,706	3,730,870	4,567,110	103,318,660	159,470,241
1924	3,894,690	10,142,099	4,323,640	5,105,139	103,184,120	161,870,113
1925	4,479,330	10,920,016	5,242,140	6,104,902	115,851,370	174,216,792
1926	4,978,530	11,149,029	4,758,630	5,744,957	124,496,360	188,308,590
1927	5,050,600	10,923,035	7,114,890	6,971,336	136,345,130	198,647,222
1928	4,716,530	10,498,440	6,824,580	5,998,825	133,869,510	196,820,697
1929	5,790,200	11,023,981	8,380,250	8,046,091	141,109,580	202,692,762

[1] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, and such other stone as can not be properly classed in any of the main groups.

Stone sold or used by producers in the United States, 1928 and 1929, by uses

Use	1928		1929	
	Quantity	Value	Quantity	Value
Building stone......cubic feet..	30,795,530	$42,769,904	34,761,140	$43,905,123
Approximate equivalent in short tons......	2,453,330		2,647.410	
Monumental stone......cubic feet..	4,203,780	14,966,498	4,410,140	15,848,126
Approximate equivalent in short tons......	347,760		366,230	
Paving blocks......number..	35,426,860	3,113,526	31,849,130	2,942.991
Approximate equivalent in short tons......	349,290		300,360	
Curbing......cubic feet..	4,832,160	4,698,313	4,054,700	3.843,961
Approximate equivalent in short tons......	383,070		336,360	
Flagging......cubic feet..	932,900	717,049	1,129,690	666,987
Approximate equivalent in short tons......	74,900		87.750	
Rubble......short tons..	907,890	1,249,703	907,810	1,324.681
Riprap......do....	3,993,190	3,865,895	4,212,990	5,030.743
Crushed stone......do....	91,265,360	94,186,259	92.721,260	94,387,878
Furnace flux (limestone and marble)......do....	23,123,870	16,957,264	24,393,500	18,034,910
Refractory stone (ganister, mica schist, and dolomite)......short tons..	1,348,160	1,745,066	1,558,200	1,807,324
Agricultural limestone......do....	2,186,870	3,153,848	2,654,580	3,764,775
Manufacturing industries (limestone and marble)......short tons..	5,639,750	4,723,810	7,430,750	6.361,201
Other......do....	1,796,070	4,673,562	3,492,380	4,774,062
Total (quantities approximate, in short tons)......	133,869,510	196,820,697	141.109.580	202,692,762

Value of stone imported for consumption in the United States, 1920–1929

Year	Value	Year	Value
1920......	$1,795,575	1925......	$2,909,887
1921......	1,253,959	1926......	3,523,578
1922......	1,895,912	1927......	4,536,407
1923......	2,641,337	1928......	3,491,353
1924......	2,437,654	1929......	3,589,259

Stone imported for consumption in the United States, 1928 and 1929, by kinds

Kind	1928		1929	
	Quantity	Value	Quantity	Value
Marble, breccia, and onyx:				
In blocks, rough, etc......cubic feet..	586,061	$1,673,344	667,900	$1,591,070
Sawed......do....	8	19	10,859	24,799
Slabs or paving tiles......superficial feet..	845,464	310,785	649,899	253,267
All other manufactures......		483,071		566,010
Mosaic cubes of marble or onyx:				
Loose......		6,015		1,875
Attached to paper......		111		33
		2,473,345		2,437,054
Granite:				
Dressed......		244,043		292,644
Rough......cubic feet..	178,427	272,428	216,022	378,943
		516,471		671,587
Stone (other):				
Dressed......		40,007		62,674
Rough (monumental or building stone)......cubic feet..	244,346	237,595	240,399	184,620
Rough (other)......		223,935		233,324
		501,537		480,618
Grand total......		3,491,353		3,589,259

Value of stone exported from the United States, 1920–1929

Year	Marble in blocks, rough or dressed, and other building or monumental stone [1]	Other manufactures of stone [1]	Total	Year	Marble in blocks, rough or dressed, and other building or monumental stone [1]	Other manufactures of stone [1]	Total
1920	$774,442	$2,158,764	$2,933,206	1925	$507,391	$725,677	$1,233,068
1921	576,905	1,697,570	2,274,475	1926	687,115	896,130	1,583,245
1922	681,658	903,102	1,584,760	1927 [2]	[3] 1,088,949	[4] 1,005,636	2,094,585
1923	625,442	783,195	1,408,637	1928 [2]	[3] 727,432	[4] 1,245,792	1,973,224
1924	499,602	448,731	948,333	1929 [2]	[3] 1,077,286	[4] 1,487,993	2,565,279

[1] Exports classification beginning 1922; prior to 1922 classification read "Stone including marble—unmanufactured and all other."

[2] Figures not separately recorded for 1927, 1928, and 1929 for stone and for cement building blocks and for stone and for cement manufactures.

[3] Composed in 1927 of "marble in blocks, rough or dressed," $237,233, and "other building or monumental stone (including cement building blocks)," $851,716; in 1928 of $254,266 and $473,166, and in 1929 of $394,654 and $682,632, respectively.

[4] Classification reads "Other manufactures of stone (including other cement manufactures)."

STRONTIUM

No domestic production of strontium ore has been reported since 1918. The canvass has been discontinued.

Strontium chemicals, manufactured in the United States from domestic and imported crude ore, sold in 1920–1924 [1]

Year	Pounds	Value	Year	Pounds	Value
1920	4,713,015	$864,251	1923	2,676,260	$303,719
1921	847,368	118,655	1924	3,061,532	303,456
1922	2,040,550	204,022			

[1] Canvass discontinued after 1924.

Imports of strontium ore have been as follows: 1929, 973 short tons, valued at $45,505; 1928, 759 tons, $31,157; 1927, 1,356 tons, $58,711; 1926, 2,200 tons, $58,159; 1925, 1,132 tons, $22,082; 1924, 1,661 tons, $14,487; 1923, 1,679 tons, $12,564. No record of similar imports was kept prior to change in tariff (September 22, 1922), but from that date until the end of the year 1,000 pounds, valued at $40, were imported.

Strontium chemicals and ore imported for consumption in the United States, 1920–1929 [1]

Year	Pounds	Value	Year	Pounds	Value
1920	1,659,083	$15,479	1925	4,826,612	$162,533
1921	1,212,758	4,393	1926	5,433,044	115,436
1922 [1]	390,644	22,986	1927	4,233,816	149,383
1923	5,281,818	131,420	1928	3,380,464	136,561
1924	3,993,226	59,937	1929	4,578,327	196,233

[1] Celestite (strontium sulphate ore), strontium nitrate, and some other chemicals not included in record prior to Sept. 22, 1922.

No exports of strontium ore or strontium chemicals have been reported.

SULPHUR

Sulphur produced and shipped in the United States, 1920–1929

Year	Produced (long tons)	Shipped		Year	Produced (long tons)	Shipped	
		Long tons	Approximate value			Long tons	Approximate value
1920	1, 255, 249	1, 517, 625	$30, 000, 000	1925	1, 409, 262	1, 858, 003	$29, 000, 000
1921	1, 879, 150	954, 344	17, 000, 000	1926	1, 890, 027	2, 072, 657	37, 300, 000
1922	1, 830, 942	1, 343, 624	22, 000, 000	1927	2, 111, 618	2, 072, 109	38, 300, 000
1923	2, 036, 097	1, 618, 841	26, 000, 000	1928	1, 981, 873	2, 082, 924	37, 500, 000
1924	1, 220, 561	1, 537, 345	25, 000, 000	1929	2, 362, 389	2, 437, 238	43, 800, 000

Sulphur imported into and exported from the United States, 1920–1929

Year	Imports for consumption		Exports	
	Long tons	Value	Long tons	Value
1920	136	$26, 828	477, 450	$8, 994, 350
1921	50	5, 878	285, 762	4, 524, 768
1922	296	14, 743	487, 969	7, 209, 357
1923	465	21, 535	474, 475	7, 216, 107
1924	1, 005	40, 293	484, 143	7, 894, 201
1925	100	4, 411	632, 250	11, 153, 781
1926	48	1, 052	582, 324	11, 154, 540
1927	3, 384	34, 487	803, 300	16, 798, 600
1928	4, 787	21, 320	704, 933	15, 051, 841
1929	1, 163	6, 616	872, 846	18, 278, 053

TALC AND SOAPSTONE

Talc and soapstone[1] *sold by producers in the United States, 1920–1929, by classes*

Year	Crude		Sawed and manufactured				Ground		Total	
			Talc		Soapstone					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1920	11, 008	$43, 820	1, 415	$139, 335	19, 707	$709, 400	178, 505	$2, 142, 894	210, 635	$3, 035, 449
1921	2, 150	12, 911	(2)	(2)	[2] 17, 423	[2] 627, 826	102, 413	1, 115, 205	121, 986	1, 755, 942
1922	4, 981	22, 582	654	86, 333	22, 700	712, 144	170, 349	2, 038, 838	198, 684	2, 859, 897
1923	5, 706	50, 125	682	114, 772	22, 857	932, 098	167, 447	1, 915, 258	196, 692	3, 012, 253
1924	5, 710	22, 247	846	109, 405	25, 630	1, 288, 885	171, 635	2, 095, 019	203, 821	3, 515, 556
1925 [1]	5, 684	24, 533	895	107, 691	(3)	(3)	175, 677	1, 879, 569	182, 256	2, 011, 793
1926 [1]	5, 988	26, 723	1, 528	130, 253	(3)	(3)	174, 052	1, 954, 018	181, 568	2, 110, 994
1927 [1]	5, 706	25, 365	1, 494	111, 650	(3)	(3)	185, 116	2, 097, 709	192, 316	2, 234, 724
1928 [1]	6, 360	48, 031	936	70, 394	(3)	(3)	195, 680	2, 419, 569	202, 976	2, 537, 994
1929 [1]	11, 228	87, 820	473	140, 928	(3)	(3)	208, 082	2, 399, 914	219, 783	2, 628, 662

[1] Beginning 1925, figures represent talc only; Bureau of Mines not at liberty to publish figures for soapstone.

[2] Talc included under "Soapstone."

[3] Bureau of Mines not at liberty to publish figures.

Talc imported for consumption in the United States, 1920–1929

Year	Crude and unground steatite and French chalk		Manufactures (except toilet preparations) wholly or partly finished [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	941	$7,206	21,739	$443,514	22,680	$450,720
1921	153	2,279	11,468	239,469	11,621	241,748
1922	248	9,850	18,196	367,528	18,444	377,378
1923	560	20,653	19,405	402,238	19,965	422,891
1924	313	4,847	17,496	337,508	17,809	342,355
1925	121	6,547	20,872	443,985	20,993	450,532
1926	199	16,366	23,642	523,716	23,841	540,082
1927	377	27,326	24,817	523,056	25,194	550,382
1928	459	33,276	26,590	546,639	27,049	579,915
1929	1,228	74,840	29,949	596,789	31,177	671,629

[1] Prior to change in tariff, Sept. 22, 1922, the classification was "Talc, steatite, and French chalk—cut, ground, or washed."

No material that might be classed as soapstone is imported.

Exports of "powders—talcum, face, compact, and bath and other toilet powders" in 1929 were valued at $1,592,301; quantity not recorded. Exports of "talcum and other toilet powders" from 1922 to 1928 were as follows: 1928, 1,568 short tons, valued at $1,605,630; 1927, 1,627 tons, $1,621,068; 1926, 1,645 tons, $1,726,933; 1925, 1,734 tons, $1,882,196; 1924, 1,614 tons, $1,688,211; 1923, 1,907 tons, $1,671,588; 1922, 1,821 tons, $1,397,542. Exports were not separately classified prior to 1922.

TANTALUM

Columbite, mined in the United States, shipped in 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	4,000	$1,450	1925	----------	----------
1921	3,400	1,150	1926	2,100	$650
1922	600	240	1927	1,100	378
1923	1,350	540	1928	34,899	26,332
1924	1,197	598	1929	22,117	17,261

No imports of tantalum or tantalum ores were recorded for 1922, 1924, or 1928. For other years in the decade 1920 to 1929 imports have been recorded as follows: 1920, 60 pounds of "ferro-alloys (tantalum)," valued at $54; 1921, 1,229 pounds of "ferro-alloys (tantalum)," $788, and 6,785 pounds of "steel-hardening ores (tantalum)," $1,327. Beginning with 1923 the classification is "Ores of ferro-alloying metals (tantalum)" and the figures are as follows: 1923, 5,600 pounds, $3,031; 1925, 5,022 pounds, $1,347; 1926, 350 pounds, $149; 1927, 15,119 pounds, $20,012; 1929, 15,250 pounds, $19,418.

No separate record of exports is kept.

TELLURIUM

Tellurium is a by-product of the electrolytic refining of copper. The production of tellurium in 1929 was 11,410 pounds, compared with an output of 2,590 pounds in 1928, 1,659 pounds in 1927, and 917 pounds in 1926. The sales in 1929 amounted to 1,309 pounds, valued at $2,710, compared with 932 pounds, valued at $1,731, in 1928, 1,003 pounds, valued at $1,913, in 1927, and 1,106 pounds, valued at $2,229, in 1926. Figures for years prior to 1926 are not available for publication.

Imports and exports of tellurium are not reported.

THORIUM MINERALS

In 1925, 2,000 pounds of monazite, estimated to contain 6 per cent of thoria, was shipped from Florida. The value of this monazite is estimated by the Bureau of Mines as $120. No monazite is known to have been produced in the United States from 1920 to 1924 or from 1926 to 1929.

Monazite sand and thorium nitrate imported for consumption in the United States, 1920–1929

Year	Monazite sand		Thorium nitrate	
	Pounds	Value	Pounds	Value
1920	1, 814, 183	$141, 528	35, 640	$43, 221
1921	50	40	44, 554	89, 672
1922	3, 466, 844	210, 187	43, 254	42, 096
1923	253, 730	11, 334	24, 027	29, 789
1924	546, 560	18, 320	14, 150	13, 721
1925	----------	----------	21, 519	22, 661
1926	669, 760	23, 816	21, 403	27, 955
1927	1, 193, 920	41, 029	10, 492	13, 514
1928	884, 800	24, 151	12, 431	14, 149
1929	1, 153, 600	26, 114	10, 164	11, 384

Exports of thorium nitrate in 1922 amounted to 1,103 pounds, valued at $3,149. Data for other years are not separately shown.

TIN

Tin mined in the United States (including Alaska), 1920–1929

[Metallic tin obtainable from concentrates produced in tin mining]

Year	Short tons	Value [1]	Year	Short tons	Value [1]
1920	22	$22, 000	1925	14	$15, 980
1921	4	2, 400	1926	8	10, 400
1922	[2] 1	912	1927	27	34, 600
1923	2	1, 623	1928	47	47, 400
1924	7	7, 028	1929	39	35, 600

[1] Value calculated at average price per pound of Straits tin in New York, as published by American Metal Market.

[2] 2,800 pounds.

Smelter production of metallic tin in the United States, 1920–1929, in short tons

1920	17, 652	1923	7, 466
1921	11, 542	1924	486
1922	9, 108	1925–1929	(1)

[1] None reported.

Secondary tin recovered as metal and in alloys and chemical compounds in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	23,500	$22,705,700	1925	30,950	$35,165,400
1921	16,900	9,668,500	1926	33,400	42,511,500
1922	19,510	12,443,500	1927	36,900	46,302,100
1923	30,210	25,316,000	1928	35,800	35,678,300
1924	31,300	31,062,100	1929	34,300	30,513,300

Metallic tin imported for consumption in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	62,795	$73,440,872	1925	85,843	$95,121,111
1921	27,101	16,645,719	1926	86,418	104,793,396
1922	67,416	40,797,986	1927	79,679	100,865,205
1923	77,206	61,092,354	1928	87,327	86,983,174
1924	72,866	68,953,193	1929	97,583	91,838,781

Tin ore (concentrate) imported into the United States, 1920–1929

[General imports]

Year	Short tons	Value	Year	Short tons	Value
1920	34,148	$18,795,162	1925	[1] 214	$98,489
1921	15,340	5,672,861	1926	[1] 339	187,396
1922	13,804	5,504,434	1927	[1] 137	79,089
1923	3,015	2,169,055	1928	[1] 146	69,227
1924	[1] 174	71,094	1929	[1] 143	66,609

[1] Recorded as tin content.

Exports of tin ore are insignificant.

Metallic tin (pigs, bars, etc.) of domestic manufacture exported from the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	706	$770,375	1925	404	$445,782
1921	1,154	748,077	1926	756	708,151
1922	901	574,792	1927	1,131	888,563
1923	840	646,250	1928	391	325,668
1924	469	453,482	1929	884	781,156

TITANIUM MINERALS

Titanium minerals produced in the United States, 1920–1929

Year	Rutile concentrates			Ilmenite concentrates		
	Short tons	Percentage of TiO_2	Value	Short tons	Percentage of TiO_2	Value
1920	277	94–96	(1)	268	50	(1)
1921	----	----	----	----	----	----
1922	310	95	(1)	5,181	52–54	(1)
1923	270	95	(1)	6,270	52	(1)
1924	----	----	----	4,769	52	[2] $76,300
1925	46	95	[2] $11,000	5,566	52	[2] 89,000
1926 [3]	30	95	[2] 7,500	4,813	52	[2] 77,000
1927	524	95	129,861	3,500	50	44,000
1928	(1)	(1)	(1)	(1)	(1)	(1)
1929	(1)	(1)	(1)	(1)	(1)	(1)

[1] Bureau of Mines not at liberty to publish figures.
[2] Estimate by Bureau of Mines.
[3] Figures for Florida only. Bureau of Mines not at liberty to publish figures for Virginia.

No imports of "titanium steel-hardening" ores have been recorded since 1918, although ilmenite is known to have been imported from Senegal, West Africa; from Brazil; from Travancore, India; and possibly from other places. Such imports were not separately classified by the Bureau of Foreign and Domestic Commerce until 1928, when 17,224 short tons of ilmenite, valued at $79,640, was imported. In 1929 imports were recorded as 25,072 short tons of ilmenite, valued at $104,887, and 6 short tons of rutile, valued at $1,463. Imports of "titanium potassium oxalate and all compounds and mixtures containing titanium" amounted to 126,156 pounds, valued at $19,094, in 1929; to 123,162 pounds, $20,136, in 1928; to 107,389 pounds, $16,145, in 1927; to 81,604 pounds, $12,232, in 1926; to 81,721 pounds, $12,368, in 1925; to 24,134 pounds, $3,639, in 1924; to 39,763 pounds, $6,423, in 1923; and to 82,544 pounds, $20,596, from September 22 to December 31, 1922. Similar imports were not separately classified prior to change in tariff. For imports of ferrotitanium see under Ferro-alloys.

No separate record of exports of titanium, "titanium steel-hardening" ores, or ferrotitanium is kept.

TRIPOLI

[See Abrasive materials]

TUNGSTEN

Concentrated tungsten ores (carrying 60 per cent of tungsten trioxide), produced in the United States, sold in 1920–1929, and average value per unit

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average per unit			Total	Average per unit
1920	216	$101,800	$7.86	1925	1,191	$755,500	$10.57
1921				1926	1,382	920,400	11.10
1922				1927	1,164	724,000	10.37
1923	241	144,600	10.00	1928	1,208	753,900	10.40
1924	565	287,000	8.47	1929	830	654,000	13.13

Tungsten-bearing ore [1] imported for consumption in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	1,949	$779,593	1925	427	$206,326
1921	1,614	276,757	1926	1,267	566,996
1922	1,651	279,190	1927	1,085	540,409
1923			1928	1,428	672,199
1924			1929	2,987	1,703,711

[1] Prior to Sept. 22, 1922, imports recorded as ore; beginning with change in tariff, recorded as tungsten content of ore.

For imports of tungsten and ferrotungsten see under Ferro-alloys.

For 1922 the following domestic exports are recorded: "Tungsten ores and concentrates (tungsten content)," 717 pounds, valued at $594. No tungsten ores of domestic production are recorded as exported in 1920 and 1921, and, although exports for later years are not separately shown, it is practically certain that no domestic ores have been exported.

For exports of tungsten and ferrotungsten see under Ferro-alloys.

URANIUM AND VANADIUM ORES

Uranium and vanadium ores shipped from mines in the United States, 1920–1929

Year	Ores		Radium isolated (grams)	Estimated content of ores		
	Short tons	Approximate value as ore		Radium (grams)	Uranium (short tons)	Vanadium (short tons)
1920	35,076	$2,401,000	32.539	43.4	143.5	526
1921	8,540	876,000	35.693	33.0	109.0	201.5
1922	929	166,016	24.189	7.0	23.2	25.9
1923	2,025	150,000	12.212	5.5	18.2	63.3
1924	(1)	(1)	(1)	(1)	(1)	(1)
1925	13,070	331,000	(1)	4.3	14.3	216
1926	21,624	329,000	(1)	.4	1.2	330.7
1927	(1)	(1)	------------	(1)	(1)	(1)
1928	(1)	(1)	------------	(1)	(1)	(1)
1929	(1)	(1)	------------	.2	.6	(1)

(1) Bureau of Mines not at liberty to publish figures.

Value of uranium salts and oxide, including radium salts, imported for consumption in the United States, 1920–1929

1920	$3	1925	$480,889
1921	8,552	1926	596,433
1922	28,685	1927	452,633
1923	500,456	1928	715,447
1924	418,307	1929	923,816

No imports of "uranium-radium ore (steel-hardening)" were recorded for 1922 to 1929. Imports in 1920 and 1921 were 396 pounds, $1,110, and 250 pounds, $446, respectively.

Vanadium ore (steel-hardening) imported for consumption in the United States, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	10,337	$1,080,935	1925	2,368	$339,468
1921	5,154	543,061	1926	8,368	914,114
1922	306	86,776	1927	6,943	561,051
1923	2,089	229,210	1928	552	49,771
1924	7,058	722,731	1929	9,760	794,734

For imports of ferrovanadium see under Ferro-alloys.

No separate record is kept of vanadium exports. For exports of ferrovanadium see under Ferro-alloys.

ZINC [1]

Primary zinc produced in the United States from domestic ores, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	450,045	$72,907,000	1925	555,631	$84,456,000
1921	198,232	19,823,000	1926	611,991	91,799,000
1922	353,274	40,273,000	1927	576,960	73,851,000
1923	508,335	69,134,000	1928	591,525	72,166,000
1924	515,831	67,058,000	1929	612,136	80,802,000

[1] For prices of zinc, see statement on p. A12.

Primary zinc produced in the United States, 1925–1929, by sources of ore, in short tons

Source	1925	1926	1927	1928	1929
United States	555, 631	611, 991	576, 960	591, 525	612, 136
Foreign:					
Canada	7, 997				
Mexico	9, 318	6, 431	15, 556	11, 056	13, 311
Total foreign	17, 315	6, 431	15, 556	11, 056	13, 311
Grand total	572, 946	618, 422	592, 516	602, 581	625, 447

Primary zinc produced in the United States, 1925–1929, by method of reduction and by location of reduction plant, in short tons

	1925	1926	1927	1928	1929
Distilled:					
Arkansas	27, 145	32, 712	26, 317	20, 505	17, 923
Illinois	109, 672	110, 381	102, 768	103, 765	110, 791
Kansas	25, 765	33, 671	33, 144	33, 923	37, 795
Oklahoma	138, 906	136, 560	120, 801	106, 557	111, 683
Pennsylvania	99, 899	100, 538	106, 099	108, 802	108, 167
Other States	92, 555	92, 964	90, 758	68, 869	82, 853
Electrolytic:					
Idaho				1, 939	16, 582
Montana [1]	79, 004	111, 596	112, 629	158, 221	[1] 139, 653
	572, 946	618, 422	592, 516	602, 581	625, 447

[1] Figures for 1929 include a small quantity from Illinois.

Secondary zinc recovered as metal in the United States, 1920–1929, in short tons

Year	Redistilled	Remelted	Recovered in alloys, excluding old brass remelted	Recovered in remelted brass (estimate)
1920	21, 371	21, 479	7, 650	65, 000
1921	17, 573	16, 260	5, 840	38, 600
1922	32, 988	36, 326	10, 250	60, 000
1923	39, 434	25, 776	8, 630	65, 000
1924	35, 486	23, 400	10, 500	63, 000
1925	39, 181	22, 249	13, 300	53, 300
1926	40, 799	23, 771	13, 430	63, 000
1927	42, 784	22, 016	12, 400	63, 200
1928	48, 666	22, 034	12, 500	66, 000
1929	47, 348	18, 052	11, 600	65, 670

Zinc imported for consumption in the United States, 1920–1929

Year	Blocks or pigs		Sheets		Old		Zinc dust		Manufactures	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1920	(1)	$17	4	$614	14	$1, 065	17	$6, 207	$1, 746	$9, 649
1921	6, 598	559, 870	6, 688	496, 445	6	341	42	1, 121	8, 290	1, 066, 067
1922	40	3, 327	416	59, 037	46	2, 403	79	5, 614	9, 517	79, 898
1923	1	375	(1)	41	20	1, 624	4	891	16, 331	19, 262
1924	11	1, 973	(1)	88	14	1, 493	59	9, 241	20, 089	32, 884
1925	(1)	303	(1)	55	24	2, 495	116	20, 936	18, 979	42, 768
1926	(1)	195	(1)	46	21	1, 315	2	451	44, 574	46, 581
1927	39	5, 089	1	271	19	1, 443	(1)	114	91, 519	98, 436
1928	(1)	66	3	2, 556	3	260	146	14, 147	115, 784	132, 813
1929	226	21, 502	(1)	52	(1)	20	159	19, 543	128, 395	169, 512

(1) Less than 1 ton.

Zinc content of zinc ores [1] *imported for consumption in the United States, 1920–1929*

Year	Short tons	Value	Year	Short tons	Value
1920	6,971	$198,156	1925	[2] 57	$6,205
1921	9,387	252,951	1926	[2] 55	4,181
1922	[2] 1,895	18,903	1927	[2] 154	10,401
1923	[2] 2,007	273,105	1928	[2] 344	19,121
1924	[2] 332	32,850	1929	[2] 2,631	208,428

[1] Classification as follows: 1920–1922, "Ore, zinc-bearing, including calamine (zinc content)"; 1923–1929, "Zinc ores (zinc content)."

[2] Content of ore imported duty free and containing less than 10 per cent of zinc is separately recorded after Sept. 21, 1922, but is excluded from figures as zinc content is not recovered.

Zinc exported from the United States, 1920–1929

Year	Domestic				Foreign slabs	
	Slabs		Sheets			
	Short tons	Value	Short tons	Value	Short tons	Value
1920	74,046	$12,495,144	11,852	$2,832,993	28,132	$4,331,636
1921	1,753	204,984	1,816	425,618	1,256	100,677
1922	26,815	2,994,625	3,217	574,491	3,471	429,122
1923	42,131	5,961,525	3,732	764,369	7,080	941,257
1924	[1] 72,583	[1] 9,538,459	3,658	784,728	(1)	(1)
1925	[1] 76,351	[1] 11,654,441	4,196	926,841	(1)	(1)
1926	[1] 42,920	[1] 6,360,671	4,641	1,086,967	(1)	(1)
1927	[1] 45,695	[1] 6,035,382	3,922	869,425	(1)	(1)
1928	[1] 25,289	[1] 3,013,679	4,325	906,515	(1)	(1)
1929	[1] 14,411	[1] 1,879,039	5,265	1,075,000	(1)	(1)

[1] Foreign included with domestic. Not separately recorded after 1923.

ZINC RESIDUUM

[See Manganiferous zinc residuum]

ZIRCONIUM MINERALS

The Bureau of Mines is advised that shipments of zircon from Pablo Beach, Fla., during the decade 1920 to 1929 were as follows:

Zircon, produced in the United States, shipped in 1920–1929

Year	Short tons	Value (estimate by Bureau of Mines)	Year	Short tons	Value (estimate by Bureau of Mines)
1920–1921	----------	----------	1926	1,292	$129,200
1922	10	$1,000	1927	3,646	364,600
1923	153	15,300	1928	(1)	(1)
1924	281	28,100	1929	----------	----------
1925	624	62,400			

[1] Bureau of Mines not at liberty to publish figures.

Zirconium ores (steel-hardening) imported for consumption in the United States, 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	----------	----------	1925	----------	----------
1921	131,016	$3,003	1926	----------	----------
1922	67,037	4,072	1927	4,488	$182
1923	----------	----------	1928	863,685	9,788
1924	616,220	4,878	1929	2,689,120	35,416

STATE TABLES

Mineral production of Alabama in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Asbestos short tons	(1)	(1)		
Asphalt (native) do	(1)	(1)	(1)	(1)
Bauxite long tons	(1)	(1)	(1)	(1)
Cement barrels	[2] 6,696,684	[2] $8,233,872	[2] 5,228,947	[2] $5,911,031
Clay products		[3] 4,072,802		[3] 4,001,633
Clay, raw short tons	131,808	[4] 178,934	108,019	[4] 185,140
Coal do	17,621,362	39,601,000	17,943,923	37,309,000
Coke do	4,327,324	[4] 13,260,178	4,753,967	[4] 12,659,148
Ferro-alloys long tons	(1 4)	(1 4)	(1 4)	(1 4)
Gold troy ounces			10	203
Graphite, crystalline pounds	1,575,500	81,785	(1)	(1)
Iron ore:				
Sold to furnaces long tons	6,159,863	11,599,176	6,637,299	12,575,113
Sold for paint do	80	(1)		
Iron, pig do	2,525,812	[4] 42,194,935	2,697,814	[4] 43,674,910
Lime short tons	192,364	1,407,232	209,260	1,223,623
Manganese ore long tons	(1)	(1)		
Manganiferous ore do			475	5,854
Mica, sheet pounds	(1)	(1)	(1)	(1)
Mineral waters gallons sold	(5)	(5)	(5)	(5)
Sand and gravel short tons	3,315,985	1,719,222	2,371,545	1,229,424
Silver troy ounces			1	1
Stone short tons	1,261,190	2,197,831	1,262,120	2,249,601
Miscellaneous [6]		3,490,308		1,427,126
Total value, eliminating duplications		69,807,334		65,402,354

[1] Value included under "Miscellaneous."
[2] Exclusive of puzzolan, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Value not included in total value for State.
[5] No canvass.
[6] Includes minerals indicated by "1" and "2" above.

Mineral production of Alaska in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Antimony ore short tons	(1)	(1)		
Arsenic do	(2)	(2)	(2)	(2)
Coal do	126,100	$662,000	100,610	$528,000
Copper pounds	41,421,000	5,964,624	40,510,000	7,129,760
Gold troy ounces	331,127	6,845,000	375,438	7,761,000
Lead short tons	1,019	118,204	1,315	165,690
Mercury flasks (76 pounds)			(1)	(1)
Natural gas M cubic feet	(1)	(1)	(1)	(1)
Natural gasoline gallons	26,000	3,000	35,000	4,000
Ores (crude), etc.:				
Copper short tons	579,500	(3)	590,400	(3)
Dry and siliceous (gold and silver) do	3,736,500	(3)	3,900,000	(3)
Petroleum barrels	(1)	(1)	(1)	(1)
Platinum and allied metals troy ounces	16	2,061	251	19,399
Silver do	454,700	266,000	472,900	252,055
Stone short tons	(1)	(1)	(1)	(1)
Tin (metallic equivalent) do	41	41,400	39	34,900
Miscellaneous [4]		122,200		52,026
Total value, eliminating duplications		14,024,489		15,946,830

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] Not valued as ore; value of recoverable metal content included under the metals
[4] Includes minerals indicated by "1" above.

Mineral production of Arizona in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Asbestos.....short tons..	(1)	(1)	934	$269,785
Clay products.....		[2] $297,159		[2] 506,215
Clay, raw.....short tons..	11,473	[3] 45,892	(1 3)	(1 3)
Coal.....do....	3,600	16,000	10,132	44,000
Copper.....pounds..	732,276,803	105,447,860	830,628,411	146,190,600
Feldspar (crude).....long tons..	(1)	(1)	(1)	(1)
Fuller's earth.....short tons..	(1)	(1)		
Gems and precious stones.....		(4)		(4)
Gold.....troy ounces..	191,927	3,967,488	202,318	4,182,287
Gypsum.....short tons..	(1)	(1)	(1)	(1)
Lead.....do....	7,190	834,096	8,027	1,011,410
Lime.....do....	36,244	343,167	42,971	397,308
Manganese ore.....long tons..	3,507	35,500	2,655	27,826
Manganiferous ore.....do....	214	(1)	45	181
Mercury.....flasks (76 pounds)..	(1)	(1)	(1)	(1)
Molybdenum.....pounds..	(1)	(1)	(1)	(1)
Ores (crude), etc.:				
Copper.....short tons..	22,584,270	(5)	25,669,975	(5)
Copper-lead and copper-lead-zinc.....do....	22,083	(5)	19,908	(5)
Dry and siliceous (gold and silver).....do....	146,825	(5)	89,904	(5)
Lead.....do....	50,651	(5)	46,476	(5)
Lead-zinc.....do....	24,937	(5)	34,421	(5)
Zinc.....do....			88	(5)
Pumice.....do....	40	300	46	321
Salt.....do....	40	400		
Sand and gravel.....do....	566,777	282,996	395,386	329,116
Silver.....troy ounces..	6,791,351	3,972,940	7,543,283	4,020,570
Sodium sulphate from natural sources.....short tons..	(1)	(1)		
Stone.....do....	408,210	221,154	616,730	582,406
Sulphuric acid (60° Baumé) [6].....do....	66,415	(1 3)	71,589	(1 3)
Tungsten ore (60 per cent concentrates).....do....			20	7,215
Vanadium ores.....do....			(1)	(1)
Zinc.....do....	639	77,997	1,229	162,266
Miscellaneous [7].....		917,680		739,308
Total value, eliminating duplications.....		115,999,643		157,959,792

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] From copper smelting.
[7] Includes minerals indicated by "1" above.

Mineral production of Arkansas in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Bauxite.....long tons..	361,236	$2,193,230	351,054	$2,181,158
Cement.....barrels..			(1)	(1)
Clay products.....		[2 3] 1,580,571		[2] 2,024,403
Clay, raw.....short tons..	266	[4] 1,064	574	[4] 2,883
Coal.....do....	1,660,973	5,615,000	1,695,108	5,624,000
Gems and precious stones.....		(5)		(5)
Iron ore sold for magnets.....long tons..	20	(1)	5	(1)
Lead.....short tons..	38	4,408	51	6,426
Lime.....do....	40,438	339,624	33,647	295,816
Manganese ore.....long tons..	3,623	81,862	4,308	94,396
Manganiferous ore.....do....	7,136	43,880	13,774	98,826
Mineral waters.....gallons sold..	(5)	(5)	(5)	(5)
Natural gas.....M cubic feet..	20,235,000	3,562,000	19,928,000	3,802,000
Natural gasoline.....gallons..	32,677,000	2,568,000	33,455,000	2,419,000
Oilstones.....short tons..	194	113,140	171	115,684
Ores (lead and zinc).....do....	(6)	(6)	(6)	(6)
Petroleum.....barrels..	32,096,000	27,450,000	24,917,000	21,890,000
Sand and gravel.....short tons..	1,683,384	991,408	3,992,336	1,851,755
Slate.....		(1)		(1)
Stone.....short tons..	381,690	441,596	551,730	761,064
Tripoli.....do....			345	3,369
Zinc.....do....	86	10,492	9	1,188
Miscellaneous [7].....		14,569		155,491
Total value, eliminating duplications.....		45,009,780		41,324,576

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass.
[6] Figures not available.
[7] Includes minerals indicated by "1" and "3" above.

Mineral production of California in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Antimony ore short tons	25	$962	----	----
Asphalt (native) do	(1)	(1)	(1)	(1)
Barite do	12,557	51,502	24,701	$147,762
Borates do	(1)	(1)	169,870	4,515,375
Briquets, fuel do	(1 2)	(1 2)	(1 2)	(1 2)
Bromine pounds	(1)	(1)	(1)	(1)
Calcium chloride short tons	(1)	(1)	(1)	(1)
Cement barrels	13,699,851	25,906,942	12,964,746	22,805,576
Chromite long tons	652	14,642	269	3,976
Clay products	----	[3] 20,993,347	----	[3] 22,733,974
Clay, raw short tons	339,497	[2] 963,843	307,473	[2] 813,171
Coal do	(1)	(1)	(1)	(1)
Copper pounds	25,150,743	3,621,707	33,218,994	5,846,543
Diatomite short tons	(1)	(1)	(1)	(1)
Feldspar (crude) long tons	11,891	81,199	12,770	84,567
Gems and precious stones	----	(4)	----	(4)
Gold troy ounces	521,740	10,785,315	412,479	8,526,703
Gypsum short tons	(1)	(1)	(1)	(1)
Iron ore sold for paint long tons	----	----	303	(1)
Lead short tons	946	109,680	715	90,058
Lime do	60,751	617,472	49,753	526,391
Magnesite do	41,300	454,300	(1)	(1)
Magnesium salts (natural) pounds	(1)	(1)	(1)	(1)
Manganese ore long tons	----	----	569	8,099
Marl, calcareous short tons	(1)	(1)	10,274	46,233
Mercury flasks (76 pounds)	6,977	861,692	10,139	1,238,428
Micaceous minerals (sericite) short tons	----	----	(1)	(1)
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Natural gas M cubic feet	246,215,000	56,695,000	342,214,000	68,972,000
Natural gasoline gallons	584,111,000	53,885,000	840,325,000	67,009,000
Ores (crude), etc.:				
Copper short tons	901,562	(5)	1,080,355	(5)
Copper-lead do	137	(5)	24	(5)
Dry and siliceous (gold and silver) do	797,441	(5)	573,724	(5)
Lead do	3,401	(5)	2,966	(5)
Peat do	(4)	(4)	(4)	(4)
Pebbles for grinding do	372	2,408	150	1,098
Petroleum barrels	231,811,000	230,000,000	292,534,000	321,367,000
Platinum and allied metals troy ounces	259	32,984	181	13,959
Potassium salts short tons	(1)	(1)	(1)	(1)
Pumice do	4,263	35,217	4,560	58,249
Pyrites long tons	(1)	(1)	(1)	(1)
Salt short tons	383,730	2,292,296	410,300	2,432,329
Sand and gravel do	15,969,132	8,698,884	15,688,545	8,371,263
Sand and sandstone (finely ground) do	(1)	(1)	2,969	30,690
Sand-lime brick thousands	(1 3)	(1 3)	(1 3)	(1 3)
Silica (quartz) short tons	5,719	47,789	5,573	58,807
Silver troy ounces	1,478,771	865,081	1,176,895	627,285
Slate	----	(1)	----	(1)
Sodium salts (carbonate, bicarbonate, and trona) from natural sources short tons	79,830	1,578,256	102,910	1,916,132
Stone do	7,838,420	7,516,482	11,818,300	10,861,539
Talc do	17,830	271,413	17,620	256,977
Tin (metallic equivalent) do	4	4,000	(6)	500
Tungsten ore (60 per cent concentrates) do	(1)	(1)	(1)	(1)
Miscellaneous [7]	----	8,840,350	----	6,367,747
Total value, eliminating duplications	----	434,261,175	----	554,916,020

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[1] Value included under "Miscellaneous."

[2] Value not included in total value for State.

[3] Figures obtained through cooperation with Bureau of the Census.

[4] No canvass.

[5] Not valued as ore; value of recoverable metal content included under the metals.

[6] 1,000 pounds.

[7] Includes minerals indicated by "1" above.

Mineral production of Colorado in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Arsenious oxide.....short tons..	115	$9,501	163	$13,201
Barite.....do....	40	340	----	----
Cement.....barrels..	(1)	(1)	(1)	(1)
Clay products.....	----	[2] 2,998,242	----	[2] 3,117,064
Clay, raw.....short tons..	155,075	[3] 256,548	162,008	[3] 215,409
Coal.....do....	9,847,707	27,613,000	9,920,741	26,254,000
Coke.....do....	750,022	(1 3)	721,457	(1 3)
Copper.....pounds..	8,594,646	1,237,629	8,905,074	1,567,293
Feldspar (crude).....long tons..	(1)	(1)	(1)	(1)
Ferro-alloys.....do....	(1 3)	(1 3)	(1 3)	(1 3)
Fluorspar.....short tons..	1,815	18,040	4,808	56,607
Fuller's earth.....do....	(1)	(1)	(1)	(1)
Gems and precious stones.....	----	(4)	----	(4)
Gold.....troy ounces..	256,623	5,304,876	213,690	4,417,358
Gypsum.....short tons..	(1)	(1)	(1)	(1)
Iron ore.....long tons..	52,713	(1)	50,754	(1)
Iron, pig.....do....	(1 3)	(1 3)	(1 3)	(1 3)
Lead.....short tons..	26,751	3,103,100	24,445	3,080,064
Lime.....do....	8,114	88,775	7,046	76,791
Manganiferous ore:				
For fluxing.....long tons..	48	(1)	----	----
For other purposes.....do....	18,599	99,823	17,770	(1)
Mica:				
Scrap.....short tons..	(1)	(1)	(1)	(1)
Sheet.....pounds..	(1)	(1)	----	----
Micaceous minerals (vermiculite)..short tons..	1	64	(1)	(1)
Mineral paints, zinc and lead pigments..do....	(1 3)	(1 3)	(1 3)	(1 3)
Mineral waters.....gallons sold..	(4)	(4)	(4)	(4)
Molybdenum.....pounds..	(1)	(1)	(1)	(1)
Natural gas.....M cubic feet..	2,931,000	786,000	2,787,000	675,000
Natural gasoline.....gallons..	1,909,000	136,000	1,630,000	113,000
Ores (crude), etc.:				
Copper.....short tons..	11,983	(5)	36,539	(5)
Copper-lead.....do....	366	(5)	81	(5)
Dry and siliceous (gold and silver)...do....	894,455	(5)	640,442	(5)
Lead.....do....	26,687	(5)	36,880	(5)
Lead-zinc.....do....	492,593	(5)	458,251	(5)
Petroleum.....barrels..	2,774,000	2,750,000	2,358,000	2,380,000
Sand and gravel.....short tons..	806,051	605,511	982,866	492,587
Shale oil.....gallons..	51,946	(6)	61,150	(6)
Silver.....troy ounces..	4,052,253	2,370,568	4,397,377	2,343,802
Stone.....short tons..	[7] 956,380	[7] 933,241	[7] 834,260	[7] 903,846
Tungsten ore (60 per cent concentrates)..do....	229	149,423	152	124,416
Uranium and vanadium ores.....do....	(1)	(1)	(1)	(1)
Zinc.....do....	35,731	4,359,182	29,431	3,884,826
Miscellaneous [8].....	----	16,433,270	----	17,741,885
Total value, eliminating duplications.....	----	58,594,688	----	55,331,911

[1] Value included under "Miscellanecus."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] No data available.
[7] Exclusive of marble, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

Mineral production of Connecticut in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Clay products		[1] [2] $2,558,384		[1] [2] $2,038,539
Clay, raw short tons	779	[3] 5,627	516	[3] 5,779
Coke do	(3 4)	(3 4)	(3 4)	(3 4)
Feldspar (crude) long tons	6,292	48,996	2,726	21,056
Lime short tons	48,152	529,936	35,180	386,855
Mica:				
Scrap do	(4)	(4)	(4)	(4)
Sheet pounds	(4)	(4)	(4)	(4)
Mineral waters gallons sold	(5)	(5)	(5)	(5)
Sand and gravel short tons	660,708	479,173	850,390	566,410
Sand-lime brick thousands			(1 4)	(1 4)
Stone short tons	2,852,980	3,743,572	[6] 2,621,260	[6] 3,496,520
Miscellaneous [7]		872,164		3,415,932
Total value, eliminating duplications		7,599,655		7,053,468

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Exclusive of pottery, value for which is included under "Miscellaneous."
[3] Value not included in total value for State.
[4] Value included under "Miscellaneous."
[5] No canvass.
[6] Exclusive of sandstone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "2," "4," and "6" above.

Mineral production of Delaware in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Clay products		[1] $274,894		[1] $230,441
Clay, raw short tons	5,638	[2] 84,736	(2 3)	(2 3)
Sand and gravel do	68,615	50,209	78,055	59,266
Stone do	(3)	(3)	(3)	(3)
Miscellaneous		156,481		257,596
Total value, eliminating duplications		481,584		467,493

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value not included in total value for State.
[3] Value included under "Miscellaneous."

Mineral production of the District of Columbia in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Clay products		[1] [2] $211,020		[1] [2] $194,908
Sand and gravel short tons	1,002,126	759,053	(3)	(3)
Sand-lime brick thousands	(1 3)	(1 3)	(1 3)	(1 3)
Stone short tons	(3)	(3)	(3)	(3)
Miscellaneous [4]		61,143		870,038
Total value, eliminating duplications		1,031,216		1,064,946

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Exclusive of pottery, value for which is included under "Miscellaneous."
[3] Value included under "Miscellaneous."
[4] Includes minerals indicated by "2" and "3" above.

Mineral production of Florida in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Cement......barrels	(1)	(1)	(1)	(1)
Clay products		[2, 3] $392,048		[2, 3] $281,741
Clay, raw......short tons	46,496	[4] 630,471	40,904	[4] 544,848
Diatomite......do	350	42,000	100	5,000
Fuller's earth......do	(1)	(1)	(1)	(1)
Lime......do	4,748	50,086	(1)	(1)
Mineral waters......gallons sold	(5)	(5)	(5)	(5)
Peat......short tons	(5)	(5)	(5)	(5)
Phosphate rock......long tons	2,883,446	9,424,022	3,088,298	9,901,074
Sand and gravel......short tons	894,879	495,875	788,298	422,409
Sand-lime brick......thousands	[2] 6,327	[2] 57,866	(1 2)	(1 2)
Stone......short tons	3,381,470	2,654,370	2,267,140	1,688,224
Titanium minerals:				
Ilmenite......do	(1)	(1)		
Rutile......do	(1)	(1)		
Zircon......do	(1)	(1)		
Miscellaneous [6]		2,110,856		2,505,158
Total value, eliminating duplications		15,227,123		14,803,606

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass.
[6] Includes minerals indicated by "1" and "3" above.

Mineral production of Georgia in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Asbestos......short tons	(1)	(1)	(1)	(1)
Barite......do	112,316	$675,509	94,118	$546,212
Bauxite......long tons	6,982	35,145	(1)	(1)
Cement......barrels	(1)	(1)	(1)	(1)
Clay products		[2] 3,656,489		[2] 3,717,673
Clay, raw......short tons	249,604	[3] 1,687,654	288,490	[3] 2,098,891
Coal......do	58,390	181,000	44,636	136,000
Coke......do	(1 3)	(1 3)		
Fuller's earth......do	100,406	1,572,041	(1)	(1)
Gold......troy ounces	44	911	125	2,574
Graphite, crystalline......pounds	(1)	(1)		
Iron ore......long tons	73,052	209,877	59,316	175,145
Lime......short tons	12,890	83,045	10,757	77,239
Manganese ore......long tons	4,727	(1)	2,521	(1)
Manganiferous ore......do	4,687	41,322	5,310	57,432
Mica, sheet......pounds	5,652	1,344	4,218	594
Micaceous minerals (chlorite schist)......short tons	(1)	(1)	(1)	(1)
Mineral waters......gallons sold	(4)	(4)	(4)	(4)
Ore (dry and siliceous) (gold and silver)......short tons	130	(5)	130	(5)
Sand and gravel......do	744,948	310,569	604,611	235,299
Silver......troy ounces	5	3	16	9
Slate		(1)		(1)
Stone......short tons	[6] 1,028,060	[6] 5,854,226	977,910	6,417,329
Talc......do	(1)	(1)	4,989	146,025
Miscellaneous [7]		2,122,917		3,782,572
Total value, eliminating duplications		14,740,431		15,294,103

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of sandstone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

Mineral production of Idaho in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Cement, barrels			(1)	(1)
Clay products		[2] $188,232		[2] $151,320
Clay, raw, short tons	494	[3] 6,095	616	[3] 7,487
Coal, do	(1)	(1)	(1)	(1)
Copper, pounds	2,072,165	298,392	5,131,438	903,133
Gems and precious stones		(4)		(4)
Gold, troy ounces	20,980	433,703	20,247	418,545
Lead, short tons	145,323	16,857,462	148,695	18,735,538
Lime, do	(1)	(1)	(1)	(1)
Manganese ore, long tons	(1)	(1)	1,326	13,707
Manganiferous ore, do			38	239
Ores (crude), etc.:				
Copper, short tons	31,454	(5)	91,782	(5)
Copper-lead and copper-lead-zinc, do	49,322	(5)	84,138	(5)
Dry and siliceous (gold and silver), do	10,571	(5)	26,583	(5)
Lead, do	1,138,581	(5)	1,021,203	(5)
Lead-zinc, do	823,951	(5)	950,414	(5)
Zinc, do	450	(5)	5	(5)
Phosphate rock, long tons	37,477	147,908	35,899	141,931
Sand and gravel, short tons	716,471	326,278	661,993	243,173
Silver, troy ounces	8,998,330	5,264,023	9,414,403	5,017,877
Stone, short tons	851,540	1,157,236	313,660	335,957
Zinc, do	31,263	3,814,126	45,675	6,029,153
Miscellaneous [6]		101,861		152,112
Total value, eliminating duplications		28,589,221		32,142,685

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Includes minerals indicated by "1" above.

Mineral production of Illinois in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Cement, barrels	[1] 7,405,667	[1] $11,602,848	[1] 7,738,208	[1] $11,134,538
Clay products		[2] 32,026,885		[2] 27,391,068
Clay, raw, short tons	248,618	[3] 466,290	264,332	[3] 553,797
Coal, do	55,948,199	112,095,000	60,657,641	113,453,000
Coke, do	3,240,964	[3] 19,967,463	4,204,116	[3] 26,036,197
Fluorspar, do	65,884	1,154,983	67,009	1,284,834
Fluorspar, optical, pounds			752	(4)
Fuller's earth, short tons	(4)	(4)	(4)	(4)
Iron, pig, long tons	4,094,514	[3] 73,524,773	4,316,096	[3] 79,672,295
Lead, short tons	385	44,660	443	55,818
Lime, do	115,523	1,017,001	119,382	973,312
Marl, calcareous, do	(4)	(4)	(4)	(4)
Mineral paints, zinc and lead pigments, do	15,986	[3] 2,004,580	17,234	[3] 2,149,882
Mineral waters, gallons sold	(5)	(5)	(5)	(5)
Natural gas, M cubic feet	3,051,000	360,000	2,983,000	388,000
Natural gasoline, gallons	7,817,000	585,000	7,080,000	617,000
Ore (lead and zinc), short tons	(6)	(6)	(6)	(6)
Peat, do	(5)	(5)	(5)	(5)
Petroleum, barrels	6,462,000	9,980,000	6,319,000	10,430,000
Sand and gravel, short tons	20,969,331	10,243,555	18,256,203	9,071,238
Sand and sandstone (finely ground), do	(4)	(4)	51,081	279,109
Silver, troy ounces	3,146	1,840	3,700	1,972
Stone, short tons	9,728,920	8,098,390	8,407,730	7,003,208
Sulphuric acid (60° Baumé) [7], do	253,335	[3] 2,505,483	291,539	[3] 2,807,521
Tripoli, do	(4)	(4)	12,889	139,557
Zinc, do	17	2,074	31	4,092
Miscellaneous [8]		886,630		564,385
Total value, eliminating duplications		188,098,866		182,791,131

[1] Exclusive of natural cement, value for which is included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] Value included under "Miscellaneous."
[5] No canvass.
[6] No ore milled in Northern Illinois; lead output of Southern Illinois is by-product of fluorspar milling.
[7] From zinc smelting.
[8] Includes minerals indicated by "1" and "4" above.

Mineral production of Indiana in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Cement……barrels..	(1)	(1)	(1)	(1)
Clay products……	…………	[2] $16,546,711	…………	[2] $18,503,240
Clay, raw……short tons..	170,512	[3] 202,215	276,610	[3] 254,358
Coal……do….	16,378,580	29,212,000	18,344,358	29,880,000
Coke……do….	6,094,201	[3] 38,237,790	6,455,378	[3] 41,208,876
Iron, pig……long tons..	3,842,762	[3] 63,622,330	4,279,825	[3] 71,416,732
Lime……short tons..	107,209	734,915	116,795	786,814
Mineral paints, zinc and lead pigments..do….	(1 3)	(1 3)	(1 3)	(1 3)
Mineral waters……gallons sold..	(4)	(4)	(4)	(4)
Natural gas……M cubic feet..	1,290,000	639,000	1,012,000	518,000
Natural gasoline……gallons..	…………	…………	2,000	(1)
Peat……short tons..	(4)	(4)	(4)	(4)
Petroleum……barrels..	1,052,000	1,580,000	981,000	1,610,000
Potassium salts……short tons..	(1)	(1)	(1)	(1)
Rubbing stones, scythestones, and whetstones……short tons..	171	23,994	(1)	(1)
Sand and gravel……do….	11,086,331	5,375,058	10,901,798	5,528,832
Sand-lime brick……thousands..	(1 2)	(1 2)	(1 2)	(1 2)
Stone……short tons..	[5] 5,102,280	[5] 22,720,411	5,129,220	22,191,883
Sulphuric acid [6]……do….	(1 3)	(1 3)	(1 3)	(1 3)
Miscellaneous [7]……	…………	24,395,264	…………	20,748,550
Total value, eliminating duplications…..	…………	98,583,915	…………	96,961,947

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[6] From zinc smelting.
[7] Includes minerals indicated by "1" and "5" above.

Mineral production of Iowa in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Cement……barrels..	6,880,731	$10,734,838	6,586,111	$9,781,159
Clay products……	…………	[1 2] 5,006,623	…………	[1 2] 5,770,125
Clay, raw……short tons..	4,054	[3] 23,500	3,200	[3] 23,281
Coal……do….	3,683,635	10,525,000	4,241,069	11,948,000
Ferro-alloys……long tons..	(3 4)	(3 4)	(3 4)	(3 4)
Gypsum……short tons..	764,044	5,355,214	718,503	4,668,856
Lime……do….	(4)	(4)	(4)	(4)
Mineral waters……gallons sold..	(5)	(5)	(5)	(5)
Natural gas……M cubic feet..	…………	…………	(4)	(4)
Sand and gravel……short tons..	3,423,619	2,094,955	4,043,609	2,211,752
Stone……do….	1,666,270	1,742,252	1,624,400	1,549,743
Miscellaneous [6]……	…………	1,191,945	…………	1,288,027
Total value, eliminating duplications…..	…………	35,498,669	…………	35,954,895

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Exclusive of pottery, value for which is included under "Miscellaneous."
[3] Value not included in total value for State.
[4] Value included under "Miscellaneous."
[5] No canvass.
[6] Includes minerals indicated by "2" and "4" above.

Mineral production of Kansas in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Cement ..... barrels	[1] 6,787,568	[1] $10,091,330	[1] 6,855,861	[1] $10,041,282
Chats ..... short tons	99,000	19,000	89,000	17,000
Clay products	-----	[2 3] 3,593,130	-----	[2 3] 3,279,953
Coal ..... short tons	2,809,724	6,861,000	2,975,971	6,697,000
Gypsum ..... do	126,227	935,595	(4)	(4)
Lead ..... do	25,276	2,932,016	26,596	3,351,096
Mineral paints, zinc and lead pigments ..... do	(4 5)	(4 5)	(4 5)	(4 5)
Mineral waters ..... gallons sold	(6)	(6)	(6)	(6)
Natural gas ..... M cubic feet	45,644,000	14,144,000	38,469,000	13,429,000
Natural gasoline ..... gallons	36,765,000	2,444,000	36,227,000	2,207,000
Ores (crude), etc.:				
Lead ..... short tons	5,500	(7)	69,500	(7)
Lead-zinc ..... do	3,083,700	(7)	3,635,900	(7)
Zinc ..... do	1,573,000	(7)	1,615,700	(7)
Petroleum ..... barrels	38,596,000	52,500,000	42,813,000	62,510,000
Pumice ..... short tons	46,836	183,589	49,768	195,784
Salt ..... do	821,950	3,573,982	840,370	3,761,984
Sand and gravel ..... do	2,760,277	1,532,399	3,389,783	1,879,899
Stone ..... do	[8] 1,203,270	[8] 1,212,598	1,419,890	1,461,146
Zinc ..... do	107,251	13,084,622	109,850	14,500,200
Miscellaneous [9]	-----	1,978,980	-----	3,092,625
Total value, eliminating duplications	-----	113,279,524	-----	124,472,480

[1] Exclusive of natural cement, value for which is included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value included under "Miscellaneous."
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included under the metals.
[8] Exclusive of sandstone, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1," "3," "4," and "8" above.

Mineral production of Kentucky in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Asphalt (native) ..... short tons	318,548	$2,757,547	340,346	$2,785,772
Cement ..... barrels	(1)	(1)	(1)	(1)
Clay products	-----	[2] 7,113,523	-----	[2] 7,062,220
Clay, raw ..... short tons	149,317	[3] 757,505	153,618	[3] 793,099
Coal ..... do	61,860,379	96,722,000	60,462,600	93,283,000
Coke ..... do	(1 3)	(1 3)	(1 3)	(1 3)
Fluorspar ..... do	69,747	1,426,766	70,827	1,390,603
Iron, pig ..... long tons	225,545	(1 3)	194,150	(1 3)
Lead ..... short tons	39	4,524	287	36,162
Lime ..... do	(1)	(1)	(1)	(1)
Mineral waters ..... gallons sold	(4)	(4)	(4)	(4)
Natural gas ..... M cubic feet	15,383,000	5,349,000	27,588,000	8,822,000
Natural gasoline ..... gallons	7,267,000	575,000	6,006,000	486,000
Ores (lead and zinc) ..... short tons	(5)	(5)	(5)	(5)
Petroleum ..... barrels	7,359,000	11,850,000	7,775,000	13,220,000
Sand and gravel ..... short tons	2,100,907	1,589,617	2,350,430	1,581,501
Stone ..... do	2,710,360	2,892,426	2,447,540	2,587,592
Zinc ..... do	92	11,224	-----	-----
Miscellaneous [6]	-----	7,883,574	-----	7,260,435
Total value, eliminating duplications	-----	131,969,907	-----	132,649,508

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Figures not available.
[6] Includes minerals indicated by "1" above.

Mineral production of Louisiana in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Cement..........barrels..	(1)	(1)	(1)	(1)
Clay products..........	----------	[2] [3] $284, 114	----------	[2] [3] $583, 513
Mineral waters..........gallons sold..	(4)	(4)	(4)	(4)
Natural gas..........M cubic feet..	227, 821, 000	20, 279, 000	261, 138, 000	26, 505, 000
Natural gasoline..........gallons..	55, 022, 000	3, 434, 000	64, 957, 000	4, 010, 000
Petroleum..........barrels..	21, 847, 000	25, 850, 000	20, 554, 000	25, 700, 000
Salt..........short tons..	630, 780	2, 405, 351	525, 840	2, 277, 366
Sand and gravel..........do....	2, 310, 166	1, 503, 400	3, 138, 673	2, 069, 024
Sand-lime brick..........thousands..	(1 2)	(1 2)	(1 2)	(1 2)
Stone..........short tons..	(1)	(1)	(1)	(1)
Sulphur..........long tons..	(1)	(1)	----------	----------
Miscellaneous [5]..........	----------	3, 054, 538	----------	1, 581, 094
Total value, eliminating duplications.....	----------	56, 810, 403	----------	62, 725, 997

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] No canvass.
[5] Includes minerals indicated by "1" and "3" above.

Mineral production of Maine in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Cement..........barrels..	373, 102	$637, 643	(1)	(1)
Clay products..........	----------	[2] 535, 088	----------	[2] $641, 364
Clay, raw..........short tons..	173	[3] 1, 884	170	[3] 2, 952
Feldspar (crude)..........long tons..	25, 063	202, 219	19, 992	142, 042
Gems and precious stones..........	----------	(4)	----------	(4)
Lime..........short tons..	123, 023	1, 056, 443	92, 428	772, 443
Marl, calcareous..........do....	500	4, 250	(1)	(1)
Mica:				
Scrap..........do....	(1)	(1)	(1)	(1)
Sheet..........pounds..	(1)	(1)	(1)	(1)
Mineral waters..........gallons sold..	(4)	(4)	(4)	(4)
Peat..........short tons..	(4)	(4)	(4)	(4)
Sand and gravel..........do....	758, 528	348, 376	2, 861, 271	447, 140
Silica (quartz)..........do....	----------	----------	(1)	(1)
Slate..........	----------	551, 242	----------	653, 627
Stone..........short tons..	413, 960	2, 579, 523	354, 500	2, 902, 603
Miscellaneous [5]..........	----------	7, 945	----------	1, 189, 580
Total value, eliminating duplications.....	----------	5, 922, 729	----------	6, 748, 799

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Includes minerals indicated by "1" above.

Mineral production of Maryland in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Asbestos short tons	(1)	(1)	(1)	(1)
Briquets, fuel do	(1 2)	(1 2)	------------	------------
Cement barrels	(1)	(1)	(1)	(1)
Chromite long tons	8	$165	------------	------------
Clay products	------------	[3] 4,586,625	------------	[3] $5,115,816
Clay, raw short tons	60,762	[2] 91,547	37,775	[2] 120,022
Coal do	2,686,979	4,954,000	2,649,114	4,640,000
Coke do	1,186,398	(1 2)	1,393,052	(1 2)
Diatomite do	------------	------------	(1)	(1)
Feldspar (crude) long tons	2,349	10,325	2,624	19,610
Iron, pig do	971,832	(1 2)	1,111,219	(1 2)
Lime short tons	59,508	440,886	54,029	404,674
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Potassium salts short tons	(1)	(1)	(1)	(1)
Sand and gravel do	2,602,142	2,409,544	3,193,486	2,853,617
Silica (quartz) do	3,515	10,466	3,670	8,875
Slate	------------	187,830	------------	214,770
Stone short tons	[5] 926,850	[5] 1,692,111	1,163,630	1,915,014
Talc do	(1)	(1)	(1)	(1)
Miscellaneous [6]	------------	27,496,564	------------	28,251,973
Total value, eliminating duplications	------------	18,417,781	------------	18,469,568

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Exclusive of marble, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of Massachusetts in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Briquets, fuel short tons	(1 2)	(1 2)	(1 2)	(1 2)
Clay products	------------	[3] $2,829,610	------------	[3] $2,571,951
Clay, raw short tons	2,158	[2] 11,848	11,791	[2] 25,717
Coke do	687,356	[2] 5,269,890	776,679	[2] 5,919,159
Fuller's earth do	(1)	(1)	(1)	(1)
Iron, pig long tons	(1 2)	(1 2)	(1 2)	(1 2)
Lime short tons	171,944	2,026,019	133,644	1,443,984
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Sand and gravel short tons	3,751,193	2,986,850	5,114,188	3,503,576
Sand-lime brick thousands	(1 3)	(1 3)	(1 3)	(1 3)
Silica (quartz) short tons	(1)	(1)	(1)	(1)
Stone do	[5] 2,879,990	[5] 7,732,247	[5] 3,127,500	[5] 8,056,302
Miscellaneous [6]	------------	3,784,035	------------	4,046,124
Total value, eliminating duplications	------------	16,234,037	------------	16,030,807

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Exclusive of sandstone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of Michigan in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Bromine ... pounds	(1)	(1)	(1)	(1)
Calcium chloride ... short tons	(1)	(1)	(1)	(1)
Cement ... barrels	14,044,230	$19,268,707	13,325,727	$18,916,711
Clay products		[2] 6,310,586		[2] 6,217,018
Clay, raw ... short tons	3,805	[3] 6,949	2,638	[3] 4,503
Coal ... do	617,342	2,631,000	804,869	2,904,000
Coke ... do	2,399,656	[3] 13,461,466	2,679,971	[3] 14,867,651
Copper ... pounds	178,442,704	25,695,749	186,402,218	32,806,790
Ferro-alloys ... long tons	(1 3)	(1 3)	(1 3)	(1 3)
Gems and precious stones		(4)		(4)
Graphite, amorphous ... short tons	(1)	(1)	(1)	(1)
Grindstones ... do			(1)	(1)
Gypsum ... do	677,108	3,159,369	898,547	4,315,334
Iron ore:				
Sold to furnaces ... long tons	14,241,102	37,039,644	16,838,568	47,597,976
Sold for paint ... do	1,950	(1)	1,514	(1)
Iron, pig ... do	797,776	[3] 15,157,535	841,089	[3] 14,099,647
Lime ... short tons	104,917	962,708	91,468	844,543
Magnesium ... pounds	530,782	289,658	908,351	512,313
Magnesium chloride (natural) ... do	(1)	(1)	(1)	(1)
Magnesium sulphate (natural) ... do	(1)	(1)	(1)	(1)
Manganiferous ore ... long tons	49,204	131,940	49,112	(1)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Natural gas ... M cubic feet	469,000	149,000	4,526,000	900,400
Ore (copper) ... short tons	7,361,658	(5)	7,598,180	(5)
Peat ... do	(4)	(4)	(4)	(4)
Petroleum ... barrels	594,000	920,000	4,528,000	6,140,000
Salt ... short tons	2,405,240	8,249,437	2,650,220	8,343,607
Sand and gravel ... do	15,893,090	6,828,431	16,844,099	7,928,744
Sand-lime brick ... thousands	[2] 103,056	[2] 1,270,778	[2] 96,511	[2] 1,107,708
Silver ... troy ounces	17,153	10,035	20,795	11,084
Stone ... short tons	12,472,600	7,588,480	[6] 13,586,230	[6] 8,454,702
Miscellaneous [7]		3,335,611		4,978,528
Total value, eliminating duplications		123,825,527		151,975,563

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of basalt, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

Mineral production of Minnesota in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay products		[2 3] $1,492,792		[2] $2,085,697
Clay, raw ... short tons	18,566	[4] 43,573	13,260	[4] 30,025
Coke ... do	622,696	[4] 5,816,566	746,004	[4] 6,478,228
Flint lining for tube mills ... do	(1)	(1)	(1)	(1)
Gems and precious stones		(5)		(5)
Iron ore ... long tons	38,129,018	94,258,899	46,470,243	121,776,312
Iron, pig ... do	341,203	(1 4)	376,551	(1 4)
Lime ... short tons	(1)	(1)	(1)	(1)
Manganiferous ore ... long tons	1,028,501	(1)	1,009,841	2,531,072
Marl, calcareous ... short tons	(1)	(1)		
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Pebbles for grinding ... short tons	(1)	(1)	(1)	(1)
Sand and gravel ... do	4,409,245	2,029,091	4,990,256	2,412,776
Sand-lime brick ... thousands	(1 2)	(1 2)	(1 2)	(1 2)
Stone ... short tons	[6] 474,450	[6] 3,699,498	517,720	4,460,383
Miscellaneous [7]		12,741,370		9,872,661
Total value, eliminating duplications		108,274,963		136,349,610

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass.
[6] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1," "3," and "6" above.

Mineral production of Mississippi in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Clay products		[1] $1,129,799		[1] $1,189,142
Clay, raw...short tons	1,320	[2] 2,310	990	[2] 1,500
Mineral waters...gallons sold	(3)	(3)	(3)	(3)
Natural gas...M cubic feet	(4)	(4)	90,000	32.000
Sand and gravel...short tons	3,012,291	1,428,548	2,766,036	1,277,746
Stone...do	(4)	(4)	(4)	(4)
Miscellaneous		76,000		73.728
Total value, eliminating duplications		2,634,347		2,572,616

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value not included in total value for State.
[3] No canvass.
[4] Value included under "Miscellaneous."

Mineral production of Missouri in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Barite...short tons	114,274	$810,203	118,679	$880,319
Briquets, fuel...do	(1 2)	(1 2)	(1 2)	(1 2)
Cement...barrels	7,943,367	12,367,018	7,984,337	11,557,905
Chats...short tons	1,904,000	476,000	2,585,200	494,800
Clay products		[3] [4] 14,891,273		[3] 14,994,548
Clay, raw...short tons	426,026	[2] 1,442,644	497,699	[2] 1,797,448
Coal...do	3,732,421	9,637,000	4,030,311	9,778,000
Coke...do	(1 2)	(1 2)	(1 2)	(1 2)
Copper...pounds	65,000	9,360	2,240	394
Iron ore...long tons	94,899	377,847	171,456	661,055
Lead...short tons	195,393	22,665,588	198,469	25,007,094
Lime...do	303,014	2,252,420	316,579	2,319,886
Mineral paints, zinc and lead pigments...do	(1 2)	(1 2)	(1 2)	(1 2)
Mineral waters...gallons sold	(5)	(5)	(5)	(5)
Natural gas...M cubic feet	360,000	217,000	324,000	164,000
Ores (crude), etc.:				
Lead...short tons	6,305,500	(6)	6,442,600	(6)
Lead-zinc...do	112,300	(6)	118,200	(6)
Zinc...do	156,000	(6)	307,200	(6)
Sand and gravel...do	5,251,226	3,248.813	5,775,729	4,291,164
Sand and sandstone (finely ground)...do	(1)	(1)	(1)	(1)
Sand-lime brick...thousands	(1 3)	(1 3)	(1 3)	(1 3)
Silver...troy ounces	176,840	103,451	181,638	96,813
Stone...short tons	3,445,690	6,137,631	4,397,800	7,085,323
Tripoli...do	(1)	(1)	(1)	(1)
Tungsten ore (60 per cent concentrates)...do	(1)	(1)		
Zinc...do	12,974	1,582,828	11,017	1,454,244
Miscellaneous [7]		3,893,827		3,798,722
Total value, eliminating duplications		74,981,382		78,948,484

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Exclusive of pottery, value for which is included under "Miscellaneous."
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Includes minerals indicated by "1" and "4" above.

Mineral production of Montana in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Arsenious oxide ..... short tons	7,120	$431,700	9,502	$550,750
Asbestos ..... do	(1)	(1)	(1)	(1)
Cement ..... barrels	(1)	(1)	(1)	(1)
Clay products	-----	[2] 397,516	-----	[2] 353,219
Clay, raw ..... short tons	24,543	[3] 73,103	19,120	[3] 23,945
Coal ..... do	3,324,195	7,550,000	3,407,526	7,561,000
Copper ..... pounds	248,262,027	35,749,732	297,725,973	52,399,771
Ferro-alloys ..... long tons	(1 3)	(1 3)	(1 3)	(1 3)
Gems and precious stones	-----	(4)	-----	(4)
Gold ..... troy ounces	58,196	1,203,020	54,758	1,131,949
Gypsum ..... short tons	(1)	(1)	(1)	(1)
Iron ore ..... long tons	1,640	5,900	-----	-----
Lead ..... short tons	16,880	1,958,059	19,607	2,470,464
Lime ..... do	(1)	(1)	(1)	(1)
Manganese ore ..... long tons	26,733	(1)	42,327	(1)
Manganiferous ore ..... do	11,156	(1)	15,665	(1)
Marl, calcareous ..... short tons	-----	-----	(1)	(1)
Micaceous minerals (vermiculite) ..... do	1,005	38,054	(1)	(1)
Mineral waters ..... gallons sold	(4)	(4)	(4)	(4)
Natural gas ..... M cubic feet	6,277,000	1,446,000	9,659,000	2,377,000
Ores (crude), etc.:				
Copper ..... short tons	3,174,509	(5)	3,802,976	(5)
Copper-lead and copper-lead-zinc ..... do	192,839	(5)	51,725	(5)
Dry and siliceous (gold and silver) ..... do	112,331	(5)	102,268	(5)
Lead ..... do	10,419	(5)	15,436	(5)
Lead-zinc ..... do	764,776	(5)	320,069	(5)
Zinc ..... do	89,405	(5)	430,971	(5)
Petroleum ..... barrels	4,015,000	6,400,000	3,980,000	7,260,000
Phosphate rock ..... long tons	-----	-----	40	400
Sand and gravel ..... short tons	1,430,914	465,375	2,446,422	667,827
Silver ..... troy ounces	10,853,276	6,349,166	12,716,977	6,778,149
Stone ..... short tons	235,180	234,334	194,320	242,412
Sulphuric acid (60° Baumé) [6] ..... do	38,298	(1 3)	(1 3)	(1 3)
Zinc ..... do	82,830	10,105,272	68,176	8,999,214
Miscellaneous [7]	-----	2,832,642	-----	3,515,776
Total value, eliminating duplications	-----	74,752,309	-----	93,842,135

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] From copper smelting.
[7] Includes minerals indicated by "1" above.

Mineral production of Nebraska in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Cement ..... barrels	(1)	(1)	(1)	(1)
Clay products	-----	[2 3] $794,851	-----	[2 3] $914,304
Clay, raw ..... short tons	19,152	[4] 19,731	17,009	[4] 19,874
Mineral waters ..... gallons sold	(5)	(5)	(5)	(5)
Pumice ..... short tons	(1)	(1)	(1)	(1)
Sand and gravel ..... do	2,234,575	1,265,001	3,370,513	1,857,065
Stone ..... do	234,590	399,971	178,200	335,789
Miscellaneous [6]	-----	994,877	-----	1,737,384
Total value, eliminating duplications	-----	3,454,700	-----	4,844,542

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass.
[6] Includes minerals indicated by "1" and "3" above.

Mineral production of Nevada in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Antimony ore .... short tons..	30	(1)		
Barite .... do....			818	$6,384
Borates .... do....	(1)	(1)		
Clay products		(1 2)		(1 2)
Clay, raw .... short tons..	13,509	[3] $61,523	8,354	[3] 42,795
Coal .... do....			(1)	(1)
Copper .... pounds..	158,876,883	22,878,271	140,138,809	24,664,430
Diatomite .... short tons..	663	10,522	540	12,097
Fluorspar .... do....	455	(1)	1,357	(1)
Fuller's earth .... do....	45,157	444,267	38,381	346,702
Gems and precious stones		(4)		(4)
Gold .... troy ounces..	175,158	3,620,833	163,711	3,384,211
Graphite, amorphous .... short tons..	(1)	(1)	(1)	(1)
Gypsum .... do....	278,405	1,424,455	225,514	1,290,854
Iron ore sold for paint .... long tons..			100	(1)
Lead .... short tons..	7,874	913,352	9,846	1,240,632
Lime .... do....	(1)	(1)	(1)	(1)
Magnesium hydrate (natural) (brucite) .... short tons..			43	774
Manganiferous ore:				
For fluxing .... long tons..	1,602	(1)		
For other purposes .... do....			2,407	21,462
Mercury .... flasks (76 pounds)..	2,867	354,061	4,764	581,899
Mineral waters .... gallons sold..	(4)	(4)	(4)	(4)
Ores (crude), etc.:				
Copper .... short tons..	6,244,047	(5)	6,572,404	(5)
Copper-lead .... do....	40,329	(5)	56,644	(5)
Dry and siliceous (gold and silver) ... do....	641,004	(5)	537,664	(5)
Lead .... do....	101,416	(5)	74,839	(5)
Lead-zinc .... do....	30,603	(5)	113,772	(5)
Zinc .... do....	34	(5)	177	(5)
Salt .... do....	(1)	(1)	(1)	(1)
Sand and gravel .... do....	201,992	150,966	1,403,255	605,079
Silica (quartz) .... do....	(1)	(1)	346	2,358
Silver .... troy ounces..	5,481,574	3,206,721	4,923,526	2,624,239
Sodium sulphate from natural sources .... short tons..	(1)	(1)	(1)	(1)
Stone .... do....	[6] 824,910	[6] 601,664	33,400	51,805
Sulphur .... long tons..	(1)	(1)	755	(1)
Tungsten ore (60 per cent concentrates) .... short tons..	551	(1)	(1)	(1)
Uranium and vanadium ores .... do....	(1)	(1)		
Zinc .... do....	3,398	414,599	8,460	1,116,725
Miscellaneous [7]		862,076		826,642
Total value, eliminating duplications		34,881,787		36,776,293

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[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of limestone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

Mineral production of New Hampshire in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Clay products	----	[1] $881,023	----	[1] $900,388
Diatomite ... short tons	10	650	10	650
Feldspar (crude) ... long tons	30,343	236,224	30,964	231,810
Garnet, abrasive ... short tons	(2)	(2)	(2)	(2)
Mica:				
Scrap ... do	1,291	25,232	1,657	35,977
Sheet ... pounds	774,143	63,470	984,778	82,657
Millstones	----	1,779	----	----
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Sand and gravel ... short tons	1,636,621	1,018,547	1,976,781	1,223,371
Scythestones ... do	(2)	(2)	----	----
Silica (quartz) ... do	376	2,593	(2)	(2)
Stone ... do	[4] 166,040	[4] 1,423,426	[4] 135,640	[4] 1,153,465
Miscellaneous [5]	----	163,121	----	97,633
Total value, eliminating duplications	----	3,816,065	----	3,725,951

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] No canvass.
[4] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[5] Includes minerals indicated by "2" and "4" above.

Mineral production of New Jersey in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Briquets, fuel ... short tons	(1 2)	(1 2)	(1 2)	(1 2)
Cement ... barrels	(1)	(1)	(1)	(1)
Clay products	----	[3] $39,379,278	----	[3] $39,417,968
Clay, raw ... short tons	260,742	[2] 1,133,848	244,258	[2] 1,023,803
Coke ... do	903,177	(1 2)	897,530	(1 2)
Ferro-alloys ... long tons	(1 2)	(1 2)	(1 2)	(1 2)
Graphite:				
Artificial ... pounds	----	----	(1 2)	(1 2)
Crystalline ... do	(1)	(1)	----	----
Iron ore:				
Sold to furnaces ... long tons	350,616	1,357,877	285,115	1,157,848
Sold for paint ... do	(1)	(1)	(1)	(1)
Iron, pig ... do	----	----	204	(1 2)
Lime ... short tons	(1)	(1)	1,644	15,618
Manganiferous residuum ... long tons	171,107	(1)	168,363	(1)
Marl, greensand ... short tons	12,965	206,582	13,016	253,180
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Ore (zinc) ... short tons	648,797	(5)	789,552	(5)
Peat ... do	(4)	(4)	(4)	(4)
Sand and gravel ... do	6,292,636	4,261,390	6,721,498	5,585,285
Sand and sandstone (finely ground) ... do	40,496	162,977	(1)	(1)
Sand-lime brick ... thousands	(1 3)	(1 3)	(1 3)	(1 3)
Slate	----	----	----	(1)
Stone ... short tons	3,186,940	4,578,642	2,740,410	4,219,553
Talc ... do	----	----	(1)	(1)
Zinc ... do	99,871	(1)	103,740	(1)
Miscellaneous [6]	----	28,232,969	----	27,901,102
Total value, eliminating duplications	----	70,865,363	----	71,891,861

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metal.
[6] Includes minerals indicated by "1" above.

Mineral production of New Mexico in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Clay products		[1] $166,351		[1] $155,138
Clay, raw ... short tons	5,338	[2] 6,597	10,347	[2] 20,021
Coal ... do	2,711,851	8,636,000	2,622,769	8,314,000
Copper ... pounds	89,854,646	12,939,069	97,717,262	17,198,238
Fluorspar ... short tons	2,589	(3)	2,438	(3)
Gems and precious stones		(4)		(4)
Gold ... troy ounces	32,912	680,360	35,176	727,162
Gypsum ... short tons	(3)	(3)	(3)	(3)
Iron ore ... long tons	184,623	(3)	171,585	(3)
Lead ... short tons	7,805	905,409	11,130	1,402,431
Lime ... do	2,002	19,665	(3)	(3)
Lithium minerals ... do	(3)	(3)	(3)	(3)
Manganese ore ... long tons	2,627	(3)	2,969	50,173
Manganiferous ore ... do	55,331	(3)	67,558	(3)
Mica:				
Scrap ... short tons	1,328	23,426	420	8,210
Sheet ... pounds	1,822	2,266	4,550	1,368
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Molybdenum ... pounds	(3)	(3)	(3)	(3)
Natural gas ... M cubic feet	838,000	66,000	3,054,000	536,000
Natural gasoline ... gallons	1,506,000	107,000	1,077,000	71,000
Ores (crude), etc.:				
Copper ... short tons	3,733,442	(5)	4,114,187	(5)
Copper-lead ... do			2,367	(5)
Dry and siliceous (gold and silver) ... do	7,016	(5)	4,858	(5)
Lead ... do	13,211	(5)	16,265	(5)
Lead-zinc ... do	249,233	(5)	306,042	(5)
Zinc ... do	71,072	(5)	63,088	(5)
Petroleum ... barrels	943,000	1,280,000	1,830,000	2,170,000
Salt ... short tons	(3)	(3)	(3)	(3)
Sand and gravel ... do	187,239	111,296	337,768	177,368
Silver ... troy ounces	827,793	484,259	1,121,546	597,784
Stone ... short tons	(3)	(3)	[6] 20,930	[6] 21,193
Zinc ... do	31,203	3,806,766	34,455	4,548,060
Miscellaneous [7]		1,198,973		1,149,496
Total value, eliminating duplications		30,426,840		37,127,621

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value not included in total value for State.
[3] Value included under "Miscellaneous."
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of limestone and sandstone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "3" and "6" above.

Mineral production of New York in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Aluminum ... pounds	(1 2)	(1 2)	(1 2)	(1 2)
Cement ... barrels	[3] 10,983,950	[3] $16,748,773	[3] 10,742,992	[3] $15,597,868
Clay products		[4] 22,474,405		[4] 17,661,711
Clay, raw ... short tons	7,214	[2] 37,201	8,155	[2] 45,553
Coke ... do	3,802,657	[2] 25,033,649	4,299,470	[2] 25,305,915
Diatomite ... do	182	12,959	186	13,249
Emery ... do	768	8,192	804	8,922
Feldspar (crude) ... long tons	13,971	120,559	12,696	103,531
Ferro-alloys ... do	209,688	[2] 17,441,639	214,826	[2] 19,729,001
Garnet, abrasive ... short tons	(1)	(1)	(1)	(1)
Graphite, artificial ... pounds	(1 2)	(1 2)	(1 2)	(1 2)
Gypsum ... short tons	1,504,826	9,613,307	1,284,338	8,339,852
Iron ore:				
Sold to furnaces ... long tons	767,743	2,906,055	875,564	3,941,985
Sold for paint ... do	(1)	(1)	(1)	(1)
Iron, pig ... do	2,369,814	[2] 39,928,960	2,626,771	[2] 46,960,186

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Exclusive of natural cement, value for which is included under "Miscellaneous."
[4] Figures obtained through cooperation with Bureau of the Census.

Mineral production of New York in 1928 and 1929—Continued

Product	1928		1929	
	Quantity	Value	Quantity	Value
Lime .... short tons..	93,354	$794,301	104,614	$906,021
Millstones	....	26,224	....	18,147
Mineral waters .... gallons sold..	(5)	(5)	(5)	(5)
Natural gas .... M cubic feet..	7,224,000	4,827,000	8,387,000	5,538,000
Natural gasoline .... gallons..	392,000	45,000	264,000	22,000
Ores (crude), etc.:				
Zinc .... short tons..	125,192	(6)	149,183	(6)
Peat .... do....	(5)	(5)	(5)	(5)
Petroleum .... barrels..	2,603,000	8,750,000	3,377,000	13,170,000
Salt .... short tons..	2,085,230	6,400,933	2,194,590	6,470,051
Sand and gravel .... do....	21,109,864	12,572,634	21,061,094	14,919,658
Sand-lime brick .... thousands..	(1 4)	(1 4)	[4] 32,711	[4] 327,173
Silica (quartz) .... short tons..	(1)	(1)	(1)	(1)
Slate	....	1,052,363	....	838,531
Stone .... short tons..	[7] 10,743,470	[7] 15,785,511	[7] 11,693,640	[7] 15,895,914
Talc .... do....	107,321	1,504,103	109,543	1,439,272
Zinc .... do....	11,257	1,373,354	10,250	1,353,000
Miscellaneous [8]	....	31,932,757	....	32,272,978
Total value, eliminating duplications	....	108,025,720	....	109,361,349

[1] Value included under "Miscellaneous."

[4] Figures obtained through cooperation with Bureau of the Census.

[5] No canvass.

[6] Not valued as ore; value of recoverable metal content included under the metal.

[7] Exclusive of basalt in 1928 and of basalt and unclassified stone in 1929, value for which is included under "Miscellaneous."

[8] Includes minerals indicated by "1," "3," and "7" above.

Mineral production of North Carolina in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Aluminum .... pounds..	(1 2)	(1 2)	(1 2)	(1 2)
Asbestos .... short tons..	....	....	(1)	(1)
Clay products	....	[3] $3,826,493	....	[3] $3,196,830
Clay, raw .... short tons..	19,898	[2] 298,951	17,683	[2] 282,682
Coal .... do....	60,860	201,000	52,180	177,000
Copper .... pounds..	8,207,000	1,181,808	(1)	(1)
Feldspar (crude) .... long tons..	105,560	630,042	103,273	598,938
Gems and precious stones	....	(4)	....	(4)
Gold .... troy ounces..	114	2,366	244	5,054
Iron ore .... long tons..	....	....	30,575	106,411
Lime .... short tons..	(1)	(1)	(1)	(1)
Manganese ore .... long tons..	10	(1)	....	....
Marl, calcareous .... short tons..	(1)	(1)	3,391	8,475
Mica:				
Scrap .... do....	4,419	69,638	3,245	53,855
Sheet .... pounds..	777,395	129,706	894,200	150,293
Micaceous minerals (biotite and muscovite schist) .... short tons..	(1)	(1)	(1)	(1)
Millstones	....	(1)	....	(1)
Mineral waters .... gallons sold..	(4)	(4)	(4)	(4)
Ores (crude):				
Copper .... short tons..	73,330	(5)	(6)	(5)
Dry and siliceous (gold and silver) ... do....	70	(5)	2,880	(5)
Sand and gravel .... do....	971,746	531,092	1,004,858	1,020,533
Silica (quartz) .... do....	4,113	40,128	2,493	28,709
Silver .... troy ounces..	19,051	11,145	21,106	11,249
Stone .... short tons..	2,126,560	4,690,949	1,607,670	3,880,113
Talc .... do....	(1)	(1)	9,439	81,306
Miscellaneous [7]	....	10,416,425	....	12,744,026
Total value, eliminating duplications	....	11,480,406	....	10,963,896

[1] Value included under "Miscellaneous."

[2] Value not included in total value for State.

[3] Figures obtained through cooperation with Bureau of the Census.

[4] No canvass.

[5] Not valued as ore; value of recoverable metal content included under the metals.

[6] Bureau of Mines not at liberty to publish figures.

[7] Includes minerals indicated by "1" above.

Mineral production of North Dakota in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Briquets, fuel...short tons			(1 2)	(1 2)
Clay products		[3] $167,121		[3] $174,892
Clay, raw...short tons	44	[2] 432	28	[2] 269
Coal...do	1,649,930	2,780,000	1,862,130	3,157,000
Mineral waters...gallons sold	(4)	(4)	(4)	(4)
Natural gas...M cubic feet	(1)	(1)	(1)	(1)
Sand and gravel...short tons	624,700	135,200	493,411	133,621
Miscellaneous		300		169,950
Total value, eliminating duplications		3,082,621		3,465,563

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.

Mineral production of Ohio in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Bromine...pounds	(1)	(1)	(1)	(1)
Calcium chloride...short tons	(1)	(1)	(1)	(1)
Cement...barrels	[2] 9,364,338	[2] $14,928,183	[2] 9,144,085	[2] $13,427,778
Clay products		[3] 81,848,422		[3] 81,797,495
Clay, raw...short tons	303,685	[4] 752,307	414,486	[4] 979,461
Coal...do	15,641,225	26,439,000	23,689,477	35,733,000
Coke...do	[5] 7,786,199	[4, 5] 33,908,863	[5] 8,521,132	[4, 5] 35,202,383
Ferro-alloys...long tons	87,221	[4] 3,652,022	85,237	[4] 3,060,184
Grindstones and pulpstones...short tons	23,877	790,203	19,944	660,195
Gypsum...do	413,948	3,805,795	374,008	3,301,440
Iron, pig...long tons	9,266,936	[4] 156,883,186	9,446,984	[4] 163,480,003
Lime...short tons	1,013,676	8,919,596	962,415	7,935,656
Marl, calcareous...do	(1)	(1)	(1)	(1)
Mineral paints, zinc and lead pigments...do	(1 4)	(1 4)	(1 4)	(1 4)
Mineral waters...gallons sold	(6)	(6)	(6)	(6)
Natural gas...M cubic feet	56,341,000	32,090,000	57,936,000	32,890,000
Natural gasoline...gallons	13,174,000	1,146,000	11,166,000	923,000
Petroleum...barrels	7,015,000	14,470,000	6,743,000	15,770,000
Rubbing stones, scythestones, and whetstones...short tons	296	45,299	279	40,014
Salt...do	1,308,110	2,988,862	1,449,360	3,199,903
Sand and gravel...do	14,286,169	9,116,356	14,250,141	9,182,862
Sand and sandstone (finely ground)...do	(1)	(1)	(1)	(1)
Sand-lime brick...thousands	(1 3)	(1 3)	(1 3)	(1 3)
Stone...short tons	13,717,410	14,195,607	14,771,030	14,957,234
Sulphuric acid [7]...do	(1 4)	(1 4)	(1 4)	(1 4)
Miscellaneous [8]		4,884,661		4,575,307
Total value, eliminating duplications		211,041,279		220,061,343

[1] Value included under "Miscellaneous."
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Value not included in total value for State.
[5] Exclusive of beehive coke, value for which is included under "Miscellaneous," but not in total value for State.
[6] No canvass.
[7] From zinc smelting.
[8] Includes minerals indicated by "1," "2," and "5" above.

Mineral production of Oklahoma in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Briquets, fuel do	--------------	--------------	(1 2)	(1 2)
Calcium chloride do	(1)	(1)	--------------	--------------
Cement barrels	(1)	(1)	(1)	(1)
Chats short tons	264,000	$40,000	240,400	$46,800
Clay products	--------------	[3] 1,726,369	--------------	[3] 1,892,919
Clay, raw short tons	--------------	--------------	31	[2] 153
Coal do	3,501,325	10,365,000	3,774,080	11,481,000
Gypsum do	397,752	2,021,635	369,433	2,255,374
Lead do	43,687	5,067,692	46,513	5,860,638
Lime do	--------------	--------------	(1)	(1)
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Natural gas M cubic feet	320,861,000	47,476,000	357,893,000	53,528,000
Natural gasoline gallons	619,691,000	40,959,000	676,030,000	42,766,000
Ores (crude), etc.:				
Lead short tons	50,000	(5)	60,400	(5)
Lead-zinc do	5,463,500	(5)	6,313,700	(5)
Zinc do	2,514,500	(5)	2,950,500	(5)
Petroleum barrels	249,857,000	347,600,000	255,004,000	364,650,000
Salt short tons	5,500	49,850	(1)	(1)
Sand and gravel do	2,827,810	1,426,258	2,904,897	1,612,755
Stone do	[6] 1,986,890	[6] 1,743,588	2,096,080	1,728,938
Sulphuric acid [7] do	(1 2)	(1 2)	(1 2)	(1 2)
Tripoli do	(1)	(1)	(1)	(1)
Zinc do	180,252	21,990,744	192,042	25,349,544
Miscellaneous [8]	--------------	6,454,240	--------------	5,929,317
Total value, eliminating duplications	--------------	486,634,347	--------------	516,685,232

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[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of sandstone, value for which is included under "Miscellaneous."
[7] From zinc smelting.
[8] Includes minerals indicated by "1" and "6" above.

Mineral production of Oregon in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Briquets, fuel short tons	(1 2)	(1 2)	(1 2)	(1 2)
Cement barrels	(1)	(1)	(1)	(1)
Clay products	--------------	[3 4] $450,205	--------------	[3] $709,494
Clay, raw short tons	(1 2)	(1 2)	1,319	[2] 2,236
Coal do	(1)	(1)	(1)	(1)
Copper pounds	358,463	51,619	655,746	115,411
Diatomite short tons	(1)	(1)	(1)	(1)
Gems and precious stones	--------------	(5)	--------------	(5)
Gold troy ounces	10,931	225,968	17,092	353,323
Lead short tons	7	768	10	1,271
Lime do	2,090	34,372	2,486	40,406
Mercury flasks (76 pounds)	3,710	458,147	3,657	446,684
Mineral waters gallons sold	(5)	(5)	(5)	(5)
Ores (crude), etc.:				
Copper short tons	4,577	(6)	3,836	(6)
Dry and siliceous (gold and silver) do	8,084	(6)	6,673	(6)
Lead do	15	(6)	--------------	--------------
Platinum and allied metals troy ounces	47	6,001	12	870
Pumice short tons	--------------	--------------	109	3,144
Sand and gravel do	2,441,945	1,453,070	2,257,338	1,508,787
Silver troy ounces	30,924	18,091	30,009	15,995
Stone short tons	1,875,250	2,117,322	[7] 1,951,890	[7] 1,905,747
Miscellaneous [8]	--------------	2,589,411	--------------	2,491,653
Total value, eliminating duplications	--------------	6,686,988	--------------	6,876,703

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[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Exclusive of pottery, value for which is included under "Miscellaneous."
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of granite, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1," "4," and "7" above.

Mineral production of Pennsylvania in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Briquets, fuel ... short tons	171,357	[1] $1,093,287	159,648	[1] $992,471
Cement ... barrels	[2] 41,161,019	[2] 62,572,588	[2] 39,309,662	[2] 55,600,953
Clay products	------------	[3] 47,928,803	------------	[3] 49,674,492
Clay, raw ... short tons	971,148	[1] 2,532,105	1,054,784	[1] 2,611,532
Coal:				
Anthracite ... do	75,348,069	393,637,690	73,828,195	385,642,751
Bituminous ... do	131,202,163	249,895,000	143,516,241	258,607,000
Coke ... do	16,917,355	[1] 62,647,772	[4] 14,489,283	[1 4] 55,088,803
Copper [5] ... pounds	4,977,885	716,815	3,454,170	607,934
Feldspar (crude) ... long tons	2,052	8,851	(6)	(6)
Ferro-alloys ... do	384,203	[1] 35,129,555	428,629	[1] 42,361,076
Gems and precious stones	------------	(7)	------------	(7)
Gold [5] ... troy ounces	992	20,506	836	17,282
Iron ore:				
Sold to furnaces ... long tons	1,013,791	2,411,114	1,151,130	2,382,839
Sold for paint ... do	1,790	(6)	1,775	(6)
Iron, pig ... do	12,289,455	[1] 216,425,084	14,058,194	[1] 257,154,601
Lime ... short tons	834,050	6,119,036	782,915	5,896,752
Micaceous minerals (vermiculite) ... do	------------	------------	(6)	(6)
Mineral paints, zinc and lead pigments ... do	(1 6)	(1 6)	(1 6)	(1 6)
Mineral waters ... gallons sold	(7)	(7)	(7)	(7)
Natural gas ... M cubic feet	99,466,000	48,432,000	101,951,000	48,821,000
Natural gasoline ... gallons	16,571,000	1,570,000	18,411,000	1,676,000
Peat ... short tons	(7)	(7)	(7)	(7)
Petroleum ... barrels	9,956,000	32,550,000	11,820,000	44,800,000
Potassium salts ... short tons	(6)	(6)	------------	------------
Sand and gravel ... do	12,955,790	11,289,826	12,674,320	13,658,328
Sand and sandstone (finely ground) ... do	(6)	(6)	(6)	(6)
Sand-lime brick ... thousands	(3 6)	(3 6)	------------	------------
Silica (quartz) ... short tons	(6)	(6)	------------	------------
Silver [5] ... troy ounces	7,905	4,624	5,972	3,183
Slate	------------	4,786,355	------------	4,798,200
Stone ... short tons	16,546,850	18,871,736	18,169,270	19,956,410
Sulphuric acid (60° Baumé) [8] ... do	128,802	[1] 1,273,852	141,634	[1] 1,363,935
Talc ... do	(6)	(6)	(6)	(6)
Tripoli (rottenstone) ... do	(6)	(6)	(6)	(6)
Miscellaneous [9]	------------	13,079,109	------------	30,536,197
Total value, eliminating duplications	------------	881,490,033	------------	892,913,833

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[1] Value not included in total value for State.
[2] Exclusive of natural cement, value for which is included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Exclusive of beehive coke, value for which is included under "Miscellaneous," but not in total value for State.
[5] Copper, gold, and silver were recovered from pyritiferous magnetite. The quantity of such ore was 1,083,140 short tons in 1928 and 1,289,266 short tons in 1929; it is included in the figures shown for iron ore.
[6] Value included under "Miscellaneous."
[7] No canvass.
[8] From zinc smelting.
[9] Includes minerals indicated by "2," "4," and "6" above.

Mineral production of Rhode Island in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Clay products	------------	------------	------------	(1 2)
Coke ... short tons	(1 3)	(1 3)	(1 3)	(1 3)
Graphite, amorphous ... do	(1)	(1)	(1)	(1)
Lime ... do	2,589	$36,875	1,885	$24,464
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Sand and gravel ... short tons	192,862	56,610	301,533	154,390
Stone ... do	149,130	707,257	141,290	590,627
Miscellaneous [5]	------------	1,164,332	------------	1,321,649
Total value, eliminating duplications	------------	830,742	------------	939,602

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[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Includes minerals indicated by "1" above.

Mineral production of South Carolina in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Barite ... short tons	(1)	(1)	(1)	(1)
Clay products	--------	[2] $1,462,055	--------	[2] $1,252,817
Clay, raw ... short tons	109,186	[3] 1,000.103	103,103	[3] 896,472
Gold ... troy ounces	10	197	--------	--------
Marl, calcareous ... short tons	(1)	(1)	3,472	9,548
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Sand and gravel ... short tons	507,716	341,391	1,068,005	602,432
Silver ... troy ounces	1	1	--------	--------
Stone ... short tons	1,278,190	2,203,863	1,067,060	1,702,575
Miscellaneous	--------	38,342	--------	24,740
Total value, eliminating duplications	--------	4,045,849	--------	3,592,112

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[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.

Mineral production of South Dakota in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay products	--------	--------	--------	(1 2)
Clay, raw ... short tons	1,066	[3] $10,660	1,275	[3] $5,100
Coal ... do	13,929	39,000	12,854	38,000
Columbite ... pounds	34,899	26,332	22,117	17,261
Feldspar (crude) ... long tons	(1)	(1)	(1)	(1)
Gems and precious stones	--------	(4)	--------	(4)
Gold ... troy ounces	317,379	6,560,805	316,837	6,549,599
Gypsum ... short tons	(1)	(1)	(1)	(1)
Lead ... do	37	4,292	--------	--------
Lime ... do	(1)	(1)	(1)	(1)
Lithium minerals ... do	(1)	(1)	(1)	(1)
Mica, scrap ... do	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Natural gas ... M cubic feet	54,000	53,000	99,000	40,000
Ores (crude), etc.:				
Dry and siliceous (gold and silver) ... short tons	1,422,138	(5)	1,463,159	(5)
Lead ... do	95	(5)	--------	--------
Sand and gravel ... do	2,461,963	1,301,075	2,729,271	578,204
Sand-lime brick ... thousands	(1 2)	(1 2)	(1 2)	(1 2)
Silver ... troy ounces	90,547	52,970	85,182	45,402
Stone ... short tons	172,360	451,869	250,440	635,890
Tin (metallic equivalent) ... do	2	2,000	(6)	200
Tungsten ore (60 per cent concentrates) ... do	(1)	(1)	5	(1)
Miscellaneous [7]	--------	952,145	--------	1,009,788
Total value, eliminating duplications	--------	9,443,488	--------	8,914,344

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[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] 500 pounds.
[7] Includes minerals indicated by "1" above.

Mineral production of Tennessee in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Aluminum ... pounds	(1 2)	(1 2)	(1 2)	(1 2)
Barite ... short tons	20,260	$150,937	26,140	$181,725
Bauxite ... long tons	460	(1)	------	------
Cement ... barrels	4,634,280	6,322,213	4,537,601	5,576,235
Clay products	------	[3] 4,030,251	------	[3] 3,695,837
Clay, raw ... short tons	123,587	[2] 613,554	110,590	[2] 585,061
Coal ... do	5,610,959	9,694,000	5,405,464	9,122,000
Coke ... do	216,925	[2] 1,063,887	209,166	[2] 1,086,374
Copper ... pounds	16,374,261	2,357,894	(1)	(1)
Ferro-alloys ... long tons	(1 2)	(1 2)	(1 2)	(1 2)
Gold ... troy ounces	538	11,117	565	11,680
Iron ore:				
Sold to furnaces ... long tons	128,478	286,524	101,796	234,827
Sold for paint ... do	(1)	(1)	375	(1)
Iron, pig ... do	102,718	[2] 1,920,901	104,985	[2] 1,938,238
Iron sinter from copper sulphide ore ... do	85,496	(1)	121,851	(1)
Lime ... short tons	183,541	1,238,945	172,936	1,036,405
Manganese ore ... long tons	55	(1)	523	12,425
Manganiferous ore ... do	763	(1)	241	1,810
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Natural gas ... M cubic feet	(1)	(1)	25,000	10,700
Ores (crude), etc.:				
Copper ... short tons	759,995	(5)	825,300	(5)
Zinc ... do	570,199	(5)	682,680	(5)
Petroleum ... barrels	46,000	70,000	19,000	30,000
Phosphate rock ... long tons	577,095	2,856,850	633,939	3,097,104
Pyrites ... do	(1)	(1)	(1)	(1)
Sand and gravel ... short tons	2,939,541	2,157,515	3,089,500	2,086,535
Silver ... troy ounces	75,558	44,201	81,281	43,323
Slate	------	(1)	------	------
Stone ... short tons	[6] 2,335,530	[6] 7,288,666	[6] 2,419,070	[6] 8,043,006
Sulphuric acid [7] ... do	(1 2)	(1 2)	(1 2)	(1 2)
Tripoli ... do	(1)	(1)	(1)	(1)
Zinc ... do	(1)	(1)	(1)	(1)
Miscellaneous [8]	------	16,602,320	------	24,092,661
Total value, eliminating duplications	------	39,216,757	------	40,719,706

[1] Value included under "Miscellaneous."

[2] Value not included in total value for State.

[3] Figures obtained through cooperation with Bureau of the Census

[4] No canvass.

[5] Not valued as ore; value of recoverable metal content included under the metals.

[6] Exclusive of sandstone, value for which is included under "Miscellaneous."

[7] From copper smelting.

[8] Includes minerals indicated by "1" and "6" above.

Mineral production of Texas in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Asphalt (native)........short tons..	321,505	$815,482	320,931	$946,003
Cement........barrels..	6,231,083	10,938,646	7,083,572	11,805,779
Clay products........	------	[1] 6,176,802	------	[1] 6,010,179
Clay, raw........short tons..	3,158	[2] 18,831	3,178	[2] 19,390
Coal........do....	1,182,034	1,589,000	1,100,668	1,600,000
Copper........pounds..	447,792	64,482	341,000	60,016
Fuller's earth........short tons..	33,388	338,080	34,249	322,215
Gems and precious stones........	------	(3)	------	(3)
Gold........troy ounces..	489	10,115	1,279	26,439
Graphite, crystalline........pounds..	(4)	(4)	(4)	(4)
Gypsum........short tons..	509,472	3,094,145	520,519	3,440,287
Lead........do....	348	40,343	425	53,530
Lime........do....	82,325	751,729	97,332	838,470
Manganese ore........long tons..	------	------	42	(4)
Marl, greensand........short tons..	(4)	(4)	250	2,500
Mercury........flasks (76 pounds)..	(4)	(4)	(4)	(4)
Mineral waters........gallons sold..	(3)	(3)	(3)	(3)
Natural gas........M cubic feet..	301,990,000	51,316,000	464,928,000	67,474,000
Natural gasoline........gallons..	324,516,000	22,492,000	419,485,000	26,561,000
Ores (crude), etc.:				
Copper........short tons..	4,494	(5)	1,456	(5)
Copper-lead........do....	------	------	20	(5)
Dry and siliceous (gold and silver)...do....	72,364	(5)	62,396	(5)
Lead........do....	57	(5)	------	------
Petroleum........barrels..	257,320,000	236,300,000	296,876,000	322,520,000
Salt........short tons..	(4)	(4)	(4)	(4)
Sand and gravel........do....	8,007,392	4,602,421	9,409,295	5,765,943
Sand-lime brick........thousands..	(1 4)	(1 4)	(1 4)	(1 4)
Silver........troy ounces..	1,340,622	784,264	1,020,516	543,935
Stone........short tons..	3,130,050	2,522,495	[6] 3,647,150	[6] 2,948,865
Sulphur........long tons..	(4)	(4)	2,435,483	43,811,000
Miscellaneous [7]........	------	36,780,951	------	1,089,339
Total value, eliminating duplications.....	------	378,616,955	------	495,819,500

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[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value not included in total value for State.
[3] No canvass.
[4] Value included under "Miscellaneous."
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of basalt, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "4" and "6" above.

Mineral production of Utah in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Arsenious oxide ..... short tons	2,674	$170,711	2,090	$120,515
Asphalt (native) ..... do	57,447	1,195,451	65,541	1,479,832
Bismuth ..... pounds	(1)	(1)		
Cement ..... barrels	(1)	(1)	(1)	(1)
Clay products		[2, 3] 444,536		[2, 3] 1,028,342
Clay, raw ..... short tons	24,897	[4] 156,951	24,426	[4] 243,233
Coal ..... do	4,842,544	12,253,000	5,160,521	12,725,000
Coke ..... do	274,600	(1 4)	281,994	(1 4)
Copper ..... pounds	293,235,039	42,225,846	318,282,523	56,017,724
Gems and precious stones		(5)		(5)
Gold ..... troy ounces	212,560	4,394,001	240,420	4,969,915
Gypsum ..... short tons	28,103	136,766	(1)	(1)
Iron ore ..... long tons	320,655	(1)	324,885	(1)
Iron, pig ..... do	164,071	(1 4)	(1 4)	(1 4)
Lead ..... short tons	145,915	16,926,141	149,377	18,821,529
Lime ..... do	47,662	385,476	46,581	365,055
Manganese ore ..... long tons			88	(1)
Manganiferous ore ..... do	286	(1)	5,942	(1)
Marl, calcareous ..... short tons	(1)	(1)	(1)	(1)
Natural gas ..... M cubic feet	1,105,000	22,000	693,000	205,000
Ores (crude), etc.:				
Copper ..... short tons	16,631,757	(6)	17,895,332	(6)
Copper-lead ..... do	45,365	(6)	44,219	(6)
Dry and siliceous (gold and silver) ..... do	211,758	(6)	255,192	(6)
Lead ..... do	341,194	(6)	374,802	(6)
Lead-zinc ..... do	1,197,043	(6)	1,262,387	(6)
Zinc ..... do			43	(6)
Petroleum ..... barrels	(1)	(1)	(1)	(1)
Potassium salts ..... short tons			(1)	(1)
Salt ..... do	85,800	193,582	84,940	202,676
Sand and gravel ..... do	1,000,131	544,020	1,588,305	722,971
Sand-lime brick ..... thousands	(1 2)	(1 2)	(1 2)	(1 2)
Silver ..... troy ounces	17,072,852	9,987,618	17,592,396	9,376.747
Stone ..... short tons	881,730	818,415	[7] 206,590	[7] 249,592
Sulphur ..... long tons	(1)	(1)	1,000	(1)
Uranium and vanadium ores ..... short tons	(1)	(1)	(1)	(1)
Zinc ..... do	46,929	5,725,298	51,510	6,799,286
Miscellaneous [8]		6,916,793		7,043,222
Total value, eliminating duplications		97,381,148		115,130,581

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Exclusive of pottery, value for which is included under "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of marble, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1," "3," and "7" above.

Mineral production of Vermont in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Asbestos ..... short tons			1,049	$47,799
Clay products		(1 2)		(1 2)
Clay, raw ..... short tons	(2 3)	(2 3)	2,639	[3] 16,673
Copper ..... pounds			(2)	(2)
Lime ..... short tons	52,445	$485,235	53,128	505,246
Mineral waters ..... gallons sold	(4)	(4)	(4)	(4)
Ore (copper) ..... short tons			31,529	(5)
Sand and gravel ..... do	295,524	108,461	170,301	58,879
Scythestones ..... do	(2)	(2)	(2)	(2)
Silver ..... troy ounces			3,284	1,750
Slate		3,981,928		3,704,894
Stone ..... short tons	[6] 448,060	[6] 9,438,796	[6] 367,240	[6] 9,435,680
Talc ..... do	52,125	502,501	60,469	546,658
Miscellaneous [7]		141,538		301,683
Total value, eliminating duplications		14,648,737		14,602,589

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "2" and "6" above.

Mineral production of Virginia in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Barite..........short tons..	(1)	(1)	(1)	(1)
Briquets, fuel..........do....	23,134	[2] $139,252	24,315	[2] $152,940
Cement..........barrels..	(1)	(1)	(1)	(1)
Clay products..........	....	[3, 4] 2,940,832	....	[3, 4] 2,948,309
Clay, raw..........short tons..	9,970	[2] 71,147	10,959	[2] 88,513
Coal..........do....	11,900,933	20,375,000	12,748,306	20,942,000
Coke..........do....	247,734	[2] 1,052,016	314,859	[2] 1,283,740
Diatomite..........do....	....	....	(1)	(1)
Emery..........do....	573	8,595	120	1,800
Feldspar (crude)..........long tons..	(1)	(1)	6,677	38,628
Ferro-alloys..........do....	(1 2)	(1 2)	(1 2)	(1 2)
Gem feldspar..........pounds..	12,000	12,000	2,200	2,200
Gypsum..........short tons..	(1)	(1)	(1)	(1)
Iron ore..........long tons..	27,970	83,114	232	631
Iron, pig..........do....	63,175	[2] 1,245,809	44,512	(1 2)
Lead..........short tons..	(1)	(1)	(1)	(1)
Lime..........do....	174,067	1,208,618	153,170	1,061,018
Manganese ore..........long tons..	3,812	(1)	3,051	(1)
Manganiferous ore..........do....	105	(1)	80	810
Marl, calcareous..........short tons..	29,818	95,108	9,554	25,702
Mica:				
Scrap..........do....	(1)	(1)	456	10,367
Sheet..........pounds..	(1)	(1)	(1)	(1)
Millstones..........	....	(1)	....	5,260
Mineral waters..........gallons sold..	(5)	(5)	(5)	(5)
Ores (crude), etc.:				
Lead-zinc..........short tons..	(6)	(7)	(6)	(7)
Zinc..........do....	....	....	(6)	(7)
Pyrites..........long tons..	(1)	(1)	(1)	(1)
Salt..........short tons..	(1)	(1)	(1)	(1)
Sand and gravel..........do....	1,602,444	1,081,948	1,728,590	1,165,358
Sand and sandstone (finely ground)..........do....	(1)	(1)	(1)	(1)
Silica (quartz)..........do....	....	....	(1)	(1)
Slate..........	....	[8] 458,153	....	[8] 434,628
Stone..........short tons..	[9] 3,289,350	[9] 3,358,104	[9] 3,605,210	[9] 3,662,569
Talc and soapstone..........do....	(1)	(1)	(1)	(1)
Titanium minerals:				
Ilmenite..........do....	(1)	(1)	(1)	(1)
Rutile..........do....	(1)	(1)	(1)	(1)
Zinc..........do....	(1)	(1)	(1)	(1)
Miscellaneous [10]..........	....	11,269,940	....	14,119,388
Total value, eliminating duplications..........	....	38,770,281	....	39,752,683

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[1] Value included under "Miscellaneous."

[2] Value not included in total value for State.

[3] Figures obtained through cooperation with Bureau of the Census.

[4] Exclusive of pottery, value for which is included under "Miscellaneous."

[5] No canvass.

[6] Bureau of Mines not at liberty to publish figures.

[7] Not valued as ore; value of recoverable metal content included under the metals.

[8] Exclusive of granules, etc., value for which is included under "Miscellaneous."

[9] Exclusive of basalt in 1928 and of marble and unclassified stone in 1929, value for which is included under "Miscellaneous."

[10] Includes minerals indicated by "1," "4," "8," and "9" above.

Mineral production of Washington in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Briquets, fuel.....short tons	63, 221	[1] $412, 603	49, 455	[1] $356, 291
Cement.....barrels	(2)	(2)	(2)	(2)
Clay products.....		[3] 1, 968, 926		[3] 2, 566, 891
Clay, raw.....short tons	35, 041	[1] 39, 632	28, 404	[1] 39, 133
Coal.....do	2, 519, 901	8, 720, 000	2, 521, 327	8, 647, 000
Coke.....do	59, 502	[1] 437, 187	66, 723	[1] 493, 827
Copper.....pounds	1, 177, 246	169, 523	1, 400, 489	246, 486
Diatomite.....short tons	804	12, 705	(2)	(2)
Gold.....troy ounces	16, 310	337, 167	3, 720	76, 898
Iron ore.....long tons	1, 012	(2)	5, 018	(2)
Lead.....short tons	542	62, 915	508	63, 956
Lime.....do	24, 529	265, 922	31, 598	324, 683
Magnesite.....do	85, 900	644, 250	(2)	(2)
Mercury.....flasks (76 pounds)	(2)	(2)	1, 397	170, 637
Mineral waters.....gallons sold	(4)	(4)	(4)	(4)
Natural gas.....M cubic feet			(2)	(2)
Ores (crude), etc.:				
Copper.....short tons	28, 560	(5)	34, 145	(5)
Copper-lead.....do	700	(5)		
Dry and siliceous (gold and silver).....do	33, 956	(5)	5, 162	(5)
Lead.....do	904	(5)	3, 176	(5)
Lead-zinc.....do	84	(5)	51, 044	(5)
Zinc.....do	350	(5)		
Pulpstones.....do	(2)	(2)	(2)	(2)
Rubbing stones.....do	(2)	(2)	(2)	(2)
Sand and gravel.....do	5, 917, 748	2, 001, 195	5, 391, 693	2, 138, 019
Silica (quartz).....do	(2)	(2)	(2)	(2)
Silver.....troy ounces	99, 738	58, 347	47, 182	25, 148
Sodium carbonate from natural sources.....short tons			(2)	(2)
Stone.....do	1, 037, 160	1, 325, 768	1, 673, 390	1, 960, 460
Zinc.....do	43	5, 204	1, 059	139, 745
Miscellaneous [6].....		6, 547, 619		6, 075, 436
Total value, eliminating duplications.....		22, 119, 541		22, 435, 359

[1] Value not included in total value for State.
[2] Value included under "Miscellaneous."
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Includes minerals indicated by "[2]" above.

Mineral production of West Virginia in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Briquets, fuel.....short tons	(1 2)	(1 2)	(1 2)	(1 2)
Bromine.....pounds	58, 400	$15, 238	85, 790	$26, 106
Calcium chloride.....short tons	1, 760	19, 112	4, 830	49, 780
Cement.....barrels	(1)	(1)	(1)	(1)
Clay products.....		[3] 19, 027, 545		[3] 20, 490, 255
Clay, raw.....short tons	41, 836	[2] 66, 621	60, 530	[2] 99, 054
Coal.....do	132, 952, 159	211, 480, 000	138, 518, 855	215, 110, 000
Coke.....do	1, 798, 900	[2] 5, 305, 393	1, 928, 583	[2] 5, 286, 427
Ferro-alloys.....long tons	(1 2)	(1 2)	(1 2)	(1 2)
Grindstones and pulpstones.....short tons	8, 857	682, 634	6, 518	516, 453
Iron, pig.....long tons	645, 038	(1 2)	653, 048	(1 2)
Lime.....short tons	279, 947	1, 788, 989	308, 600	1, 865, 531
Marl, calcareous.....do	(1)	(1)	(1)	(1)
Mineral waters.....gallons sold	(4)	(4)	(4)	(4)
Natural gas.....M cubic feet	163, 018, 000	72, 265, 000	167, 333, 000	73, 793, 000
Natural gasoline.....gallons	69, 729, 000	6, 220, 000	72, 994, 000	6, 285, 000
Petroleum.....barrels	5, 661, 000	17, 150, 000	5, 574, 000	20, 070, 000
Salt.....short tons	18, 700	149, 421	20, 290	153, 477
Sand and gravel.....do	2, 383, 659	2, 773, 341	2, 667, 940	2, 893, 542
Sand and sandstone (finely ground).....do	(1)	(1)	(1)	(1)
Stone.....do	[5] 3, 143, 780	[5] 2, 908, 657	3, 375, 590	3, 056, 174
Sulphuric acid [6].....do	(1 2)	(1 2)	(1 2)	(1 2)
Miscellaneous [7].....		13, 971, 405		15, 367, 604
Total value, eliminating duplications.....		336, 636, 948		346, 564, 746

[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[6] From zinc smelting.
[7] Includes minerals indicated by "[1]" and "[5]" above.

Mineral production of Wisconsin in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Barite, short tons	(1)	(1)	976	$4,212
Briquets, fuel, do	586,611	[2] $4,904,443	729,159	[2] 5,949.852
Cement, barrels	(1)	(1)	(1)	(1)
Clay products		[3] [4] 1,007,826		[3] 2,801,309
Clay, raw, short tons	508	[2] 983	500	[2] 500
Coke, do	(1 2)	(1 2)	(1 2)	(1 2)
Iron ore:				
Sold to furnaces, long tons	1,394,371	3,700,797	1,789,721	4,848,978
Sold for paint, do	2,292	(1)	1,515	(1)
Iron, pig, do	(1 2)	(1 2)		
Lead, short tons	1,698	196,968	1,536	193,536
Lime, do	163,965	1,374,749	130,902	1,094,388
Mineral paints, zinc and lead pigments, short tons	(1 2)	(1 2)	(1 2)	(1 2)
Mineral waters, gallons sold	(5)	(5)	(5)	(5)
Ores (crude), etc.:				
Lead, short tons			400	(6)
Lead-zinc, do	627,300	(6)	404,300	(6)
Zinc, do	106,200	(6)	202,400	(6)
Pyrites, long tons	(1)	(1)	(1)	(1)
Sand and gravel, short tons	10,104,015	3,680,420	10,727,632	4,574,182
Sand-lime brick, thousands	(1 3)	(1 3)	(1 3)	(1 3)
Silica (quartz), short tons	(1)	(1)	(1)	(1)
Stone, do	3,313,740	5,516,017	[7] 4,004,200	[7] 6,166,708
Sulphuric acid [8], do	(1 2)	(1 2)	(1 2)	(1 2)
Talc, do			4,350	14,238
Zinc, do	18,417	2,246,874	16,986	2,242,152
Miscellaneous [9]		9,483,240		8,273,837
Total value, eliminating duplications		20,938,179		24,222,229

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[1] Value included under "Miscellaneous."
[2] Value not included in total value for State.
[3] Figures obtained through cooperation with Bureau of the Census.
[4] Exclusive of pottery, value for which is included under "Miscellaneous."
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of basalt and unclassified stone, value for which is included under "Miscellaneous."
[8] From zinc smelting.
[9] Includes minerals indicated by "1," "4," and "7" above.

Mineral production of Wyoming in 1928 and 1929

Product	1928		1929	
	Quantity	Value	Quantity	Value
Cement, barrels			(1)	(1)
Clay products		[2] $103,426		[2] $172,630
Clay, raw, short tons	22,921	[3] 383,994	22,055	[3] 190,171
Coal, do	6,571,683	17,363,000	6,704,790	17,052,000
Copper, pounds	2,604	375	4,301	757
Gold, troy ounces	33	677	48	995
Gypsum, short tons	(1)	(1)	(1)	(1)
Iron ore, long tons	491,280	(1)	639,477	(1)
Mineral waters, gallons sold	(4)	(4)	(4)	(4)
Natural gas, M cubic feet	47,490,000	3,527,000	44,648,000	3,850,000
Natural gasoline, gallons	42,861,000	2,775,000	44,544,000	3,241,000
Ores (crude), etc.:				
Copper, short tons	29	(5)	28	(5)
Dry and siliceous (gold and silver), short tons	100	(5)	115	(5)
Petroleum, barrels	21,461,000	27,400,000	19,314,000	24,700,000
Phosphate rock, long tons	3,388	14,399	2,679	12,750
Sand and gravel, short tons	1,742,880	414,004	(1)	(1)
Silver, troy ounces	53	31	26	14
Sodium sulphate from natural sources, short tons	(1)	(1)	(1)	(1)
Stone, do	[6] 280,180	[6] 454,136	322,260	473,678
Miscellaneous [7]		898,827		1,733,583
Total value, eliminating duplications		52,950,875		51,237,407

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[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] Value not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

PREFATORY NOTE TO THE REPORTS ON GOLD, SILVER, COPPER, LEAD, AND ZINC

By O. E. Kiessling

Chief Economist, Division of Mineral Statistics

In the mining industry, gold, silver, copper, lead, and zinc are closely related in both the genesis and the geologic occurrence of their ores, as well as in mining and in metallurgical treatment. Of their ores some contain all five metals, many contain three of four, and few contain only one. Gold and silver, for instance, almost everywhere show close genetic relations, and their ores are usually mined together. Lead and zinc constitute a similar pair. Copper ores almost invariably yield some silver and gold as well as copper, and most lead ores yield notable supplies of silver. Zinc ores in the Western States contribute also to the production of silver. All five metals may occur in commercial quantity in a single mine or, more commonly, in a single mining district. For these reasons each of these metals is treated in Mineral Resources in a general report, and all five metals are grouped together in "mine reports" descriptive of individual or geographically grouped States. These reports are printed in 15 pamphlets.

To facilitate advance publication each report is published separately at the earliest date possible. The general reports give figures of the output of the metals in the first marketable form, as obtained from the smelters, refineries, and mints, together with general reviews of the respective industries for the entire country. The figures given in the general reports represent the final official statistics of production for the country and of the States. The general report on gold and silver includes the statistics of recovered precious metals as determined by the Bureau of the Mint. The "mine reports" give figures of the production (called "mine production") as obtained from the mines, so far as possible in terms of both gross and recoverable metal in ores and other material sold or treated during the year; they also supply information in detail relative to the mining industry in the respective States, counties, and mining districts.

These reports, which appear as separate chapters in this volume, are as follows:

Gold and silver (general report).
Copper (general report).
Lead (general report).
Zinc (general report).

Silver, copper, lead, and zinc in the Central States (mine report).
Gold, silver, copper, lead, and zinc in the Eastern States (mine report).
Gold, silver, copper, lead, and zinc in Arizona (mine report).
Gold, silver, copper, lead, and zinc in California and Oregon (mine report).
Gold, silver, copper, lead, and zinc in Colorado (mine report).
Gold, silver, copper, lead, and zinc in Idaho and Washington (mine report).
Gold, silver, copper, lead, and zinc in Montana (mine report).
Gold, silver, copper, lead, and zinc in Nevada (mine report).
Gold, silver, copper, lead, and zinc in New Mexico and Texas (mine report).
Gold, silver, copper, and lead in South Dakota and Wyoming (mine report).
Gold, silver, copper, lead, and zinc in Utah (mine report).

In stating quantity of ores, concentrates, and similar material the short ton of 2,000 pounds is used throughout. The term "ore" as used here denotes any metalliferous material treated at the mine or shipped to reduction plants and paid for by those plants, whether or not it nets a profit to the miner. The ore classification is necessarily arbitrary, because of the varying factors affecting mining and treatment of ores. Dry and siliceous ores comprise gold and silver ores proper, as well as fluxing ores that carry considerable quantities of iron and manganese oxides and very small quantities of gold and silver and also gold and silver ores that carry copper, lead, or zinc in quantities too low to classify them as copper, lead, zinc, or mixed ores. The copper ores include the great disseminated copper deposits of the West, the copper ores of the Lake Superior region, and other ores in which copper is the most abundant base metal paid for. The lead and zinc ores are those in which lead or zinc is the only or chief base metal present, irrespective of their precious-metal content. The mixed ores are those whose commercial value depends on the recoverable or recovered contents of two or more base metals in addition to any precious metals they may contain. If one of the metals, though present in sufficient quantity, is not recovered, that metal is disregarded in naming the ore. An improvement in metallurgy may later serve to change the name of such ore. The classification based on methods of treatment is the only satisfactory commercial classification.

It is to be understood, of course, that market values are not received by producers for metals in ore and intermediate products nor always for metals in marketable form, that payment is made in accordance with contracts for treatment or sale, and therefore that average daily quotations do not necessarily agree with average prices received.

Prices of silver, copper, lead, and zinc, 1850–1929

Year	Silver [1]	Copper [2]	Lead [3]	Zinc [4]	Year	Silver [1]	Copper [2]	Lead [3]	Zinc [4]
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1850	$1.32	$0.22	$0.05	----------	1890	$1.05	$0.156	$0.045	$0.055
1851	1.34	.166	.05	----------	1891	.99	.128	.043	.05
1852	1.33	.22	.05	----------	1892	.87	.116	.041	.046
1853	1.35	.22	.06	$0.055	1893	.78	.108	.037	.04
1854	1.35	.22	.06	----------	1894	.63	.095	.033	.035
1855	1.34	.27	.07	----------	1895	.65	.107	.032	.036
1856	1.34	.27	.066	----------	1896	.68	.108	.03	.039
1857	1.35	.25	.06	----------	1897	.60	.12	.036	.041
1858	1.34	.23	.06	----------	1898	.59	.124	.038	.046
1859	1.36	.22	.055	----------	1899	.60	.171	.045	.058
1860	1.35	.23	.056	----------	1900	.62	.166	.044	.044
1861	1.33	.22	.05	----------	1901	.60	.167	.043	.041
1862	1.35	.22	.06	----------	1902	.53	.122	.041	.048
1863	1.345	.34	.06	----------	1903	.54	.137	.042	.054
1864	1.345	.47	.07	.139	1904	.58	.128	.043	.051
1865	1.337	.392	.066	----------	1905	.61	.156	.047	.059
1866	1.339	.342	.07	----------	1906	.68	.193	.057	.061
1867	1.33	.254	.065	----------	1907	.66	.20	.053	.059
1868	1.326	.23	.065	----------	1908	.53	.132	.042	.047
1869	1.325	.242	.06	----------	1909	.52	.13	.043	.054
1870	1.328	.212	.06	----------	1910	.54	.127	.044	.054
1871	1.325	.241	.06	----------	1911	.53	.125	.045	.057
1872	1.322	.356	.064	----------	1912	.615	.165	.045	.069
1873	1.297	.280	.06	----------	1913	.604	.155	.044	.056
1874	1.278	.220	.06	----------	1914	.553	.133	.039	.051
1875	1.24	.227	.058	.07	1915	.507	.175	.047	.124
1876	1.16	.21	.061	.072	1916	.658	.246	.069	.134
1877	1.20	.19	.055	.06	1917	.824	.273	.086	.102
1878	1.15	.166	.036	.049	1918	1.00	.247	.071	.091
1879	1.12	.186	.041	.052	1919	1.12	.186	.053	.073
1880	1.15	.214	.05	.055	1920	1.09	.184	.08	.081
1881	1.13	.182	.048	.052	1921	1.00	.129	.045	.05
1882	1.14	.191	.049	.053	1922	1.00	.135	.055	.057
1883	1.11	.165	.043	.045	1923	.82	.147	.07	.068
1884	1.11	.13	.037	.044	1924	.67	.131	.08	.065
1885	1.07	.108	.040	.043	1925	.694	.142	.087	.076
1886	.99	.111	.046	.044	1926	.624	.14	.08	.075
1887	.98	.138	.045	.046	1927	.567	.131	.063	.064
1888	.94	.168	.044	.049	1928	.585	.144	.058	.061
1889	.94	.135	.039	.05	1929	.533	.176	.063	.066

[1] Report of Director of the Mint, pp. 212–213, 1914. Equivalent value of fine ounce based on average price and average rate of exchange. For 1916, 1917, and 1919, dealers' buying price, New York. For 1918, early estimate furnished by the Bureau of the Mint. For 1920 to 1922, New York market price for domestic silver only. For 1923, average price under Pittman Act, from Jan. 1 to June 2, for domestic silver; average New York price for all silver after that period. For 1924 and later years, average New York price for bar silver.

[2] Weed, W. H., Copper Handbook, vol. 11, pp. 1339, 1343, for years 1850–1903. By computation from data for years 1850–1860, p. 1339. U. S. Geological Survey computations for electrolytic copper since 1904. For 1916 and later years, average price all marketable grades.

[3] New York price, Ingalls, W. R., Lead and Zinc in the United States, p. 203, 1908. U. S. Geological Survey since 1904. For 1916, outside spot quotations, New York. For 1917 and later years, average price all grades.

[4] New York price, 1875–1904, Ingalls, W. R., Lead and Zinc in the United States, p. 342, 1908. St. Louis price, U. S. Geological Survey, since 1904. For 1915 and later years, average price all grades. Oral communication from C. E. Siebenthal, of the U. S. Geological Survey, for 1853 and 1864.

ARSENIC [1]

By V. C. Heikes [2]

PRODUCTION AND SALES

Production of arsenic (arsenious oxide) in the United States in 1929 amounted to 16,605 short tons, of which 11,071 tons was refined and 5,534 tons was crude. All of the output was a by-product from smelting copper and lead ores. The products for the market consisted of refined white arsenic, crude white arsenic, "flue" dust, and "treater" dust. No production of red arsenic sulphide or elemental arsenic was reported.

Of the refined and crude arsenic produced 14,546 tons was sold; it was valued at $883,771, or 3.04 cents a pound. The refined white arsenic, 9,823 tons, was sold for $646,887, or 3.29 cents a pound; the crude arsenic, 4,723 tons, was sold for $236,884, or 2.51 cents a pound. Crude and refined white arsenic sold by producers in the United States during the past 10 years is shown in the following table.

Crude and refined white arsenic sold by producers in the United States, 1920–1929

Year	Short tons		Value	
	Refined	Crude	Total	Average (cents per pound)
1920	10, 942	560	$2, 021, 356	8. 8
1921	3, 427	1, 359	717, 700	7. 5
1922	8, 905	1, 122	1, 475, 229	7. 4
1923	12, 357	1, 914	2, 808, 801	9. 8
1924	12, 270	2, 183	2, 655, 015	9. 2
1925	11, 240	1, 077	$1, 199, 247	4. 9
1926	10, 977	828	674, 350	2. 9
1927	10, 020	1, 540	725, 360	3. 1
1928	8, 115	3, 652	735, 373	3. 1
1929	9, 823	4, 723	883, 771	3. 0

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[1] Work on manuscript completed June, 1930.

[2] Figures on imports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

IMPORTS

Arsenic compounds and metallic arsenic imported for consumption in the United States, 1920–1929

Year	Arsenious acid (white arsenic, As_2O_3)		Arsenic sulphide (realgar and orpiment)		Sheep dip		Paris green and London purple	
	Short tons	Value	Short tons	Value	Pounds	Value	Pounds	Value
1920	3,740	$532,635	4,080	$684,016	70,168	$5,150	772	$277
1921	1,669	253,250	3,343	531,322	61,377	6,362	325	123
1922	1,081	162,494	3,815	472,044	70,390	4,877	3,866	741
1923	10,152	1,985,400	1,097	268,311	87,739	5,237	100,781	20,586
1924	8,877	1,597,433	234	45,246	114,801	10,764	76,241	15,683
1925	9,316	1,076,073	476	63,296	73,477	4,953	2,880	702
1926	7,703	510,227	283	40,718	119,947	14,070	4,747	1,011
1927	12,517	921,998	206	35,089	102,394	8,952	----------	----------
1928	11,153	775,169	263	51,278	175,055	17,592	13,279	1,497
1929	13,157	956,176	212	40,976	208,770	21,533	1,102	200

Year	Arsenic acid (H_3AsO_4)		Calcium arsenate		Lead arsenate		Metallic arsenic	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1920–21	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
1922 [2]	41,296	$4,195	----------	----------	----------	----------	22,487	$3,484
1923	166,354	15,597	----------	----------	26	$9	174,415	37,314
1924	420	121	3,172	$278	3,585	525	122,467	23,684
1925	59,112	2,676	1,074	135	10,467	1,514	149,018	31,918
1926	2,340	165	1,057	284	----------	----------	174,490	35,745
1927	11,685	470	3,807	717	----------	----------	245,686	47,875
1928	75	30	1,323	233	----------	----------	186,622	35,584
1929	247	26	----------	----------	200	26	287,545	50,730

[1] Figures not available.
[2] Figures cover period Sept. 22 to Dec. 31. Not separately classified prior to change in tariff.

White arsenic imported into the United States in 1929, by countries and districts

[General imports]

Country	Short tons	Value	District	Short tons	Value
Belgium	964	$68,053	Buffalo	401	$31,011
Canada	1,489	113,522	El Paso	636	25,453
Germany	30	2,694	Galveston	17	1,184
Japan	708	23,721	Hawaii	42	2,785
Mexico	9,966	748,186	Los Angeles	34	2,315
			Maryland	429	28,372
			Michigan	732	57,337
			New Orleans	11	755
			New York	5,260	450,262
			Ohio	246	16,788
			Philadelphia	489	23,709
			San Antonio	4,518	304,257
			San Francisco	342	11,948
	13,157	956,176		13,157	956,176

MARKET IN 1929

DEMAND AND SUPPLY

In 1929 three smelting companies sold by-product arsenic from current production and stock on hand. More than nine-tenths of this arsenic was recovered from the smelting of copper ores, and the remainder came from lead ores and iron concentrates. Montana and Utah ores were the chief sources of arsenic recovered at the smelting plants of the Anaconda Copper Mining Co., the American Smelting & Refining Co., and the United States Smelting, Refining & Mining Co.

Insecticide manufacturers were the largest consumers of the domestic supply, utilizing 60 per cent of the total output. Requirements for arsenic weed-killer and wood-preserver mixtures, made chiefly by western manufacturers, declined from 25 per cent of the total sales in 1928 to 16 per cent in 1929. The glass industry took its usual amount, representing 10 per cent of the total output in 1929. Arsenic of the highest grade is usually sold to insecticide and glass manufacturers; crude arsenic, including "flue" dust and "treater" dust, is used for weed-killer and for wood-preserving purposes. Other uses reported were purifying gas and refining cobalt.

Imports of crude and refined arsenic during 1929 amounted to 13,157 short tons. This, added to the 16,605 tons produced in 1929, indicates 29,762 tons as the total new supply of white arsenic available.

Mexico was credited with three-fourths of the arsenic imported in 1929; the arsenic was produced at the by-product plants of the Mexican lead works of the American Smelting & Refining Co. and the American Metal Co. Canada exported to the United States 1,489 tons of white arsenic in addition to considerable arsenic contained in ores and concentrates shipped to smelters. Arsenical gold concentrates were also shipped from a gold mine in British Columbia to the Tacoma smelter in Washington. Alaska ores and concentrates treated at the Tacoma smelter yielded arsenic; this increased the domestic output. Most of the arsenic imported from Japan, fourth on the list of sources of imported arsenic, was recovered as a by-product from smelting copper ores.

PRICES

The price quoted in New York for white arsenic delivered at the consuming point seems to have been uniformly 4 cents a pound for large lots, but small lots were quoted at a higher price. At 4 cents a pound the price includes freight from the refinery to the buyer's works and barreling; freight averaged about one-half cent a pound and barreling one-half cent. These items account for the difference between quoted prices and the average value of product as reported by the producers.

Arsenious acid or white arsenic under the tariff act of 1922 is on the free list. Some domestic mine owners with whom arsenic is an important product made a proposal in 1929 for tariff protection on arsenic. The congressional committees acted unfavorably on the proposal.

WORLD PRODUCTION

World production of arsenic ore and white arsenic, 1924–1928, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country and product	1924	1925	1926	1927	1928
Algeria: Arsenate of lead—					
Gross weight	9, 335	6, 750	3, 665	2, 482	1, 201
Arsenic content	1, 587	1, 148	733	546	300
Australia:					
New South Wales—					
Ore and concentrates	4, 487	3, 400	[1] 1, 796	755	5, 924
White arsenic	328	301	202	(2)	50
Queensland—					
Ore	(2)	1, 133	828	71	---------
White arsenic	573	---------	---------	---------	---------
South Australia—Ore—					
Gross weight	69	102	---------	---------	---------
Arsenic content	(2)	(2)	---------	---------	---------
Victoria—White arsenic	437	(2)	(2)	(2)	(2)
Austria:					
Ore [3]—					
Gross weight	560	89	---------	---------	---------
Arsenic content	40	15	---------	---------	---------
Arsenic content of gold ores	216	237	155	14	---------
Belgium: White arsenic	1, 850	(4)	(4)	(4)	(4)
Brazil: White arsenic	146	(2)	51	(2)	(2)
Canada:					
White arsenic	1, 631	910	1, 807	2, 220	1, 821
Arsenic content of ores and concentrates [5]	465	648	495	605	643
China:					
Ore [5]	472	395	(2)	(2)	(2)
White arsenic [5]	237	94	(2)	(2)	(2)
Chosen:					
Ore	---------	(2)	---------	---------	---------
White arsenic	---------	[5] 107	---------	---------	---------
Czechoslovakia: Ore—					
Gross weight	217	34	4	13	6
Arsenic content	(2)	(2)	1	3	1
France:					
Ore	14, 029	30, 349	23, 256	55, 800	74, 720
White arsenic	802	2, 217	2, 096	(2)	(2)
Germany: Ore and concentrates [6]—					
Gross weight	10, 818	6, 626	3, 930	4, 710	4, 373
Arsenic content	3, 499	2, 085	1, 353	1, 639	1, 499
Great Britain:					
Ore	304	(7)	---------	81	---------
White arsenic and arsenic soot	3, 258	2, 586	1, 693	1, 358	1, 314
Greece: White arsenic	1, 096	423	1, 148	1, 036	709
Italy: Ore—					
Gross weight	147	4	200	81	(2)
Arsenic content	33	1	35	20	(2)
Japan:					
Ore	7, 416	(2)	(2)	(2)	(2)
White arsenic	3, 703	3, 485	1, 035	1, 713	1, 829
Mexico: White arsenic	3, 401	7, 507	6, 445	11, 332	12, 933
Peru:					
Ore	---------	(2)	---------	---------	---------
Arsenic	---------	[8] 119	---------	---------	---------
Portugal:					
Ore	279	76	7	47	155
White arsenic	874	1, 092	354	(2)	(2)
Southern Rhodesia: White arsenic	533	170	49	38	102
Spain: Ore—					
Gross weight	---------	---------	190	186	---------
Arsenic content	---------	---------	29	28	---------
Sweden: Ore—					
Gross weight	80	110	13, 149	22, 100	22, 728
Arsenic content	19	21	2, 478	4, 420	4, 546
Union of South Africa: White arsenic	102	33	38	53	17
United States: White arsenic	13, 111	11, 174	10, 709	10, 487	10, 675

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[1] Exclusive of output of Ottery mine, data for which are not available.
[2] Data not available.
[3] Exclusive of arsenical gold ores worked primarily for their gold and silver content.
[4] Belgium reports production of white arsenic, but neither quantity nor value is stated.
[5] Exports.
[6] Data relate to concentrates produced and ore sold without concentration.
[7] Production reported, but figures not available for publication.
[8] White arsenic exported by the Anglo-French Ticapampa Silver Mining Co. (Ltd.).

IRON ORE, PIG IRON, AND STEEL[1]

By HUBERT W. DAVIS[2]

GENERAL REVIEW

In 1929 the production and the shipments of iron ore increased 17 and 19 per cent, respectively, as compared with 1928. The production in 1929 was 119 per cent of the average for the preceding 5 years and 125 per cent of the average for the preceding 10 years. The output of pig iron, including ferro-alloys, increased 12 per cent as compared with 1928, and was the largest on record. It was 117 per cent of the average for the preceding 5 years and 127 per cent of the average for the preceding 10 years.

The average value per ton of iron ore at the mines in 1929 was 15 cents higher than in 1928 and that of pig iron at the blast furnaces advanced 34 cents a ton. The quoted prices of ferromanganese and spiegeleisen were also higher than in 1928. Earnings of 21 of the leading steel manufacturers in the United States, according to the Iron Trade Review,[3] showed a return on capitalization of 10.5 per cent in 1929, as compared with 6.55 per cent in 1928.

According to Iron Age,[4] automobiles held the lead gained in 1928 in consumption of steel, with 18 per cent of the total in both years. Building and other construction of all kinds (except that for railroads) was slightly ahead of railroads in tonnage consumed in 1928, but the reverse was true in 1929. Building and construction took 16.5 per cent of the total in both years, but fell to third place in 1929, whereas the railroads increased their consumption from 16 per cent of the total in 1928 to 17 per cent in 1929, and advanced to second place. Among the smaller outlets for steel production, the oil, gas, water, and mining industries accounted for 10.5 per cent of the total, exports and agriculture for 5.5 per cent each, containers for 5 per cent, and machinery for 3 per cent.

The total domestic output of pig iron required about 82 per cent of the annual capacity, according to figures of the American Iron and Steel Institute, but this capacity was not utilized steadily. At the beginning of 1929 there were 203 furnaces in blast, on June 30 there were 225, and at the end of the year there were 165. The production of steel ingots is considered to have been about 87 per cent of the rated capacity, having ranged from about 56 per cent in December to 102 per cent in May. The output of pig iron in the United States in 1929 represented about 44 per cent of the world production and was about 14 per cent less than that of the producing countries of Europe combined. The production of pig iron in Europe increased 10 per cent in 1929, compared with an increase of 12 per cent in the United States.

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[1] Work on manuscript completed June, 1930.

[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

[3] Iron Trade Review, Steel Earnings Rise to Level of Other Basic Industries: Vol. 86, Apr. 24, 1930, pp. 68–69, 114.

[4] Iron Age, Automobiles Took Most Steel: Vol. 125 ,Jan. 2, 1930, pp. 9–11.

The iron-ore mining industry in the Lake Superior district was more active in 1929 than in any year since 1917, and the production was only 1.4 per cent less than the record made in 1916. Eastern furnaces took about 1,200,000 tons of Lake ore in 1929, as compared with about 350,000 tons in 1928. A computation of iron mining costs in Michigan in 1929, made by the State mine appraiser, shows that the operators' gross profit at underground mines was 99 cents a ton, as compared with 66 cents a ton in 1928, and that the gross profit at siliceous open-pit mines in 1929 was 16 cents a ton, as compared with a loss of 1.2 cents a ton in 1928. These figures are probably representative of the entire Lake Superior district and show the ability of the operators, in the face of a maintained wage scale, to effect economies in an industry already highly specialized and efficient. The season of 1929 ended with stock piles smaller than at the close of any season since 1909. The total decrease in stocks in the Lake Superior district amounted to 23 per cent.

IRON ORE

QUANTITIES MINED AND SHIPPED IN 1929

In the following table the quantities of iron ore shown include ore that was beneficiated—that is, treated in any way—as well as crude ore not requiring treatment. The figures on both production and shipments include the iron ore used for fluxing other metallic ores at smelters in the Western States, but the shipments do not include the iron ore sold for the manufacture of paint, which amounted to 14,066 gross tons in 1929, valued at $90,352, or $6.42 a ton, compared with 15,906 tons in 1928, valued at $83,190, or $5.23 a ton. The output of manganiferous iron ore that contained 5 per cent or more of manganese amounted to 1,188,258 gross tons, valued at $3,274,466, as compared with 1,177,632 tons (including ore used for flux), valued at $3,053,307, in 1928. In Arkansas one producer shipped a small quantity of loadstone, which is not included in the tabulated statistics of iron ore. Neither do the statistics include iron sinter recovered from copper sulphide ore, 118,449 gross tons of which, averaging about 64 per cent of iron, was made in Tennessee in 1929.

Iron ore was mined in 18 States in 1929, as compared with 17 States in 1928, Montana and Virginia having dropped out and California, Nevada, and North Carolina having been added. A small quantity of ore from New Jersey was used for purifying gas; all the output from Washington was used in the manufacture of ferromagnesite; the ore produced in the remaining States was mainly for use in the manufacture of pig iron and steel; small quantities produced in California, Michigan, Nevada, New Jersey, New York, Pennsylvania, Tennessee, and Wisconsin were used for paint. The rank of the three States producing the largest quantity of iron ore—Minnesota, Michigan, and Alabama—remained unchanged. Minnesota is producing more iron ore than all the rest of the States together and has furnished a little more than 60 per cent of the total for the United States in the last five years.

The ores of iron are classed under the four heads—hematite, brown ore, magnetite, and carbonate. Notes on the composition of these ores are given in Mineral Resources, 1916, Part I, pp. 537–541.

Iron ore mined in the United States, 1928 and 1929, by States and varieties, in gross tons

[Exclusive of ore containing 5 per cent or more of manganese]

State	Number of active mines	Hematite	Brown ore	Magnetite	Carbonate	Total
1928						
Alabama	24	5,668,493	639,351			6,307,844
Colorado	1		52,713			52,713
Georgia	4		73,052			73,052
Michigan	64	13,676,984				13,676,984
Minnesota	84	37,564,005				37,564,005
Missouri	2	94,899				94,899
Montana	3		1,640			1,640
New Jersey	3			250,332		250,332
New Mexico	1			184,623		184,623
New York	5	(1)		[1] 712,757		712,757
Pennsylvania	3			1,022,080	1,790	1,023,870
Tennessee	6	83,662	45,266			128,928
Utah	1	320,655				320,655
Virginia	2	23,287	4,615			27,902
Washington	1			1,012		1,012
Wisconsin	6	1,284,592				1,284,592
Wyoming	1	491,280				491,280
	211	[1] 59,207,857	816,637	[1] 2,170,804	1,790	62,197,088
1929						
Alabama	28	5,826,912	626,163			6,453,075
California	1		303			303
Colorado	1		50,754			50,754
Georgia	6		59,316			59,316
Michigan	58	15,456,397				15,456,397
Minnesota	85	45,760,858				45,760,858
Missouri	4	167,301	1,633			168,934
Nevada	1		100			100
New Jersey	4			281,327		281,327
New Mexico	1			171,585		171,585
New York	5	(1)		[1] 822,261		822,261
North Carolina	2			30,675		30,675
Pennsylvania	2			1,090,238	1,775	1,092,013
Tennessee	5	68,755	33,416			102,171
Utah	2	[2] 320,960	[2] 3,925			324,885
Washington	1			5,018		5,018
Wisconsin	4	1,608,571				1,608,571
Wyoming	1	639,477				639,477
	211	[1, 2] 69,849,231	[2] 775,610	[1] 2,401,104	1,775	73,027,720

[1] Some hematite included with magnetite.

[2] Some hematite included with brown ore.

Iron ore mined in the United States in 1929, by States and counties

State and county	Active mines	Gross tons
Alabama:		
Blount	5	228,064
Calhoun	3	2,581
Cherokee	4	5,556
Etowah	1	12,769
Franklin	2	143,374
Jefferson	6	5,814,143
Tuscaloosa	4	239,358
Butler	1	7,230
Talladega	2	
	28	6,453,075
California: Alameda	1	303
Colorado: Saguache	1	50,754
Georgia:		
Bartow	1	8,725
Polk	5	50,591
	6	59,316
Michigan:		
Baraga	1	91,374
Dickinson	5	1,289,150
Gogebic	17	5,553,199
Iron	20	4,068,209
Marquette	15	4,454,465
	58	15,456,397
Minnesota:		
Crow Wing	9	1,506,119
Itasca	22	8,243,618
St. Louis	54	36,011,121
	85	45,760,858
Missouri:		
Crawford	1	31,753
Franklin	1	
Stoddard	1	
St. Francois	1	137,181
	4	168,934
Nevada: Elko	1	100
New Jersey:		
Morris	3	281,327
Passaic	1	
	4	281,327
New Mexico: Grant	1	171,585
New York:		
Clinton	1	160,946
Essex	1	580,748
Oneida	1	80,567
Orange	1	
Wayne	1	
	5	822,261
North Carolina:		
Ashe	1	100
Avery	1	30,575
	2	30,675
Pennsylvania:		
Carbon	1	1,775
Lebanon	1	1,090,238
	2	1,092,013
Tennessee:		
Dickson	2	8,880
Hickman	1	24,536
Hamilton	1	68,755
Roane	1	
	5	102,171
Utah:		
Iron	1	320,960
Utah	1	3,925
	2	324,885
Washington: Stevens	1	5,018
Wisconsin:		
Dodge	1	1,058
Florence	1	71,110
Iron	2	1,536,403
	4	1,608,571
Wyoming: Platte	1	639,477
Total for United States	211	73,027,720

Iron ore mined in the United States, by mining districts and varieties, 1928 and 1929, in gross tons

[Exclusive of ore containing 5 per cent or more of manganese]

District	Hematite	Brown ore	Magnetite	Carbonate	Total
1928					
Lake Superior [1]	52,517,175				52,517,175
Birmingham	5,658,021	509,173			6,167,194
Chattanooga	94,134	98,372			192,506
Adirondack			[2] 963,089		[2] 963,089
Northern New Jersey and southeastern New York					
Other districts	[2] 938,527	209,092	1,207,715	1,790	[2] 2,357,124
	[2] 59,207,857	816,637	[2] 2,170,804	1,790	62,197,088
1929					
Lake Superior [1]	62,824,768				62,824,768
Birmingham	5,814,143	467,422			6,281,565
Chattanooga	81,524	74,429			155,953
Adirondack			[2] 749,976		[2] 749,976
Northern New Jersey and southeastern New York			353,612		353,612
Other districts	[2,3] 1,128,796	[3] 233,759	1,297,516	1,775	[2] 2,661,846
	[2,3] 69,849,231	[3] 775,610	[2] 2,401,104	1,775	73,027,720

[1] Includes only those mines in Wisconsin that are in the true Lake Superior district.
[2] Some hematite from "Other districts" included with magnetite from Adirondack district.
[3] Some hematite included with brown ore.

The Lake Superior district, which comprises Minnesota, Michigan, and northern Wisconsin, mined a little more than 86 per cent of the total ore produced in 1929, and the Birmingham district mined a little less than 9 per cent. The Lake Superior, Birmingham, Adirondack, and northern New Jersey and southeastern New York districts each produced more ore in 1929 than in 1928.

The following table shows the production of iron ore in the United States so far as it has been recorded or estimated. The figures for the years prior to 1860 are not strictly accurate, as they were calculated from the pig iron produced and included both imported and domestic ore. Details for 1880 to 1916 may be found in Mineral Resources for 1916.

Iron ore mined in the United States, 1810–1929, in gross tons

[Exclusive after 1905 of ore containing 5 per cent or more of manganese]

Year	Hematite	Brown ore	Magnetite	Carbonate	Total
1810–1869					49, 656, 000
1870 [1]–1880					51, 690, 889
1881–1890					103, 854, 386
1891–1900	136, 961, 046	22, 845, 764	14, 634, 364	1, 065, 137	175, 506, 311
1901–1910	364, 179, 432	[2] 28, 287, 994	[2] 20, 664, 453	262, 366	413, 394, 245
1911–1915	239, 419, 251	8, 355, 102	10, 156, 539	42, 495	257, 973, 387
1916	70, 728, 024	1, 904, 484	2, 533, 364	1. 800	75, 167, 672
1917	70, 743, 513	1, 992, 332	2, 553, 006		75, 288, 851
1918	65, 894, 709	1, 613, 844	2, 149, 725		69, 658, 278
1919	[3] 57, 719, 582	1, 127, 397	[3] 2, 118, 439		60, 965, 418
1920	[3 4] 63, 883, 523	[4] 1, 325. 661	[3] 2, 391, 541	3, 740	67, 604, 465
1921	[3 4] 28, 337, 249	[4] 370, 154	[3] 780, 866	2, 709	29, 490, 978
1922	[4] 44, 888, 723	[4] 783, 582	1, 452, 966	3, 256	47, 128, 527
1923	[4] 65, 924, 454	[4] 1, 232, 848	2, 190, 624	3, 516	69, 351, 442
1924	[4] 52, 102, 300	[4] 814, 159	1, 347, 711	3, 249	54, 267, 419
1925	[4] 59, 546, 690	[4] 884, 600	1, 472, 004	4, 703	61, 907, 997
1926	[4 5] 64, 634, 573	[4] 810, 924	[5] 2, 175, 288	2, 215	67, 623, 000
1927	[4 5] 58, 505, 543	[4] 743, 478	[5] 2, 489. 586	2, 493	61, 741, 100
1928	[5] 59, 207, 857	816, 637	[5] 2, 170, 804	1, 790	62, 197, 088
1929	[4 5] 69, 849, 231	[4] 775, 610	[5] 2, 401, 104	1, 775	73, 027, 720
					1, 927, 495, 173

[1] Includes ore produced by owners of blast furnaces, estimated by census at 800,000 tons.
[2] Some brown ore included with magnetite.
[3] Some magnetite included with hematite.
[4] Some hematite included with brown ore.
[5] Some hematite included with magnetite.

No iron ore was reported as sold for use in fluxing other metallic ores at smelters in the Western States in 1929, but 7,586 gross tons, valued at $12,215, was reported for such use in 1928. The ore sold for purifying gas amounted to 1,016 gross tons, as compared with 1,484 tons in 1928. The domestic iron ore sold for the manufacture of pig iron and steel in 1929 amounted to 75,596,700 gross tons, valued at $197,118,452, as compared with 63,422,744 tons, valued at $155,759,441, in 1928.

Iron ore shipped from mines in the United States, 1928 and 1929, by States

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

State	1928		1929	
	Gross tons	Value	Gross tons	Value
Alabama	6,159,863	$11,599,176	6,637,299	$12,575,113
Colorado	52,713	(1)	50,754	(1)
Georgia	73,052	209,877	59,316	175,145
Michigan	14,241,102	37,039,644	16,838,568	47,597,976
Minnesota	38,129,018	94,258,899	46,470,243	121,776,312
Missouri	94,899	377,847	171,456	661,055
Montana	1,640	5,900	---	---
New Jersey	350,616	1,357,877	285,115	1,157,848
New Mexico	184,623	(1)	171,585	(1)
New York	767,743	2,906,055	875,564	3,941,985
North Carolina	---	---	30,575	106,411
Pennsylvania	1,013,791	2,411,114	1,151,130	2,382,839
Tennessee	128,478	286,524	101,796	234,827
Utah	320,655	(1)	324,885	(1)
Virginia	27,970	83,114	232	631
Washington	1,012	(1)	5,018	(1)
Wisconsin	1,394,371	3,700,797	1,789,721	4,848,978
Wyoming	491,280	(1)	639,477	(1)
Undistributed	---	[2] 1,551,833	---	[2] 1,689,520
	63,432,826	155,788,657	75,602,734	197,148,640

[1] Included under "Undistributed."

[2] This figure includes value for States entered as "(1)" above.

Iron ore shipped from mines in the United States, 1920–1929

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

Year	Gross tons	Value	Year	Gross tons	Value
1920	69,281,341	$285,006,327	1925	63,924,763	$160,796,886
1921	26,652,528	89,745,308	1926	69,292,832	174,015,645
1922	50,612,620	157,809,286	1927	61,232,473	151,125,820
1923	69,811,472	240,738,921	1928	63,432,826	155,788,657
1924	52,083,375	151,307,105	1929	75,602,734	197,148,640

PRINCIPAL IRON-ORE MINES

In 1929, 211 iron-ore mines were active, compared with 211 also in 1928 and 232 in 1927; 130 mines produced more than 100,000 gross tons of iron ore each, compared with 124 in 1928 and 131 in 1927. Of these 130 mines 14 (9 in Minnesota, 2 in Alabama, 1 in Wisconsin, 1 in Pennsylvania, and 1 in Michigan) produced more than 1,000,000 tons each, compared with 10 (7 in Minnesota, 2 in Alabama, and 1 in Michigan) in 1928 and 10 (6 in Minnesota, 2 in Alabama, 1 in Michigan, and 1 in Pennsylvania) in 1927. The operators of all of these large mines have permitted the publication of output; the figures are given in the table that follows. The predominance of hematite as an iron ore is clearly shown by the fact that of these 130 large mines only 5 produced magnetite and 1 produced brown ore. The trend toward large mining units is shown in the production of nearly 97 per cent of the output of the country by the 130 mines which yielded more than 100,000 tons each. The 14 mines that produced more than 1,000,000 tons each in 1929 furnished nearly 46 per cent of the total. The average production per mine in 1929 was 346,103 gross tons, as compared with 294,773 tons in 1928.

Iron-ore mines of the United States that produced more than 100,000 gross tons each in 1929

Rank	Name of mine	State	Nearest town	Variety of ore	Gross tons
1	Missabe Mountain	Minnesota	Virginia	Hematite	6, 252, 287
2	Sellers	do	Hibbing	do	5, 031, 846
3	Mahoning	do	do	do	4, 041, 001
4	Red Mountain group	Alabama	Bessemer	do	3, 013, 343
5	Hull-Rust	Minnesota	Hibbing	do	2, 559, 412
6	Adams-Spruce group	do	Eveleth	do	2, 162, 775
7	Hill Annex	do	Calumet	do	1, 813, 341
8	Woodward Nos. 1 and 3	Alabama	Bessemer	do	1, 386, 306
9	Hartley-Burt	Minnesota	Chisholm	do	1, 346, 169
10	Montreal	Wisconsin	Montreal	do	1, 270, 370
11	Morris	Minnesota	Hibbing	do	1, 221, 517
12	Leonidas	do	Eveleth	do	1, 199, 421
13	Cornwall	Pennsylvania	Miners Village	Magnetite	1, 090, 238
14	Norrie-Aurora	Michigan	Ironwood	Hematite	1, 053, 022
15	Pioneer	Minnesota	Ely	do	930, 106
16	Morrison	do	Coleraine	do	821, 332
17	Dunwoody	do	Chisholm	do	770, 044
18	Bennett	do	Keewatin	do	765, 561
19	Negaunee	Michigan	Negaunee	do	656, 317
20	Sunrise	Wyoming	Sunrise	do	639, 477
21	Sloss Nos. 1 and 2	Alabama	Bessemer	do	637, 455
22	Newport	Michigan	Ironwood	do	636, 138
23	Wakefield	do	Wakefield	do	620, 636
24	Sunday Lake	do	do	do	620, 161
25	Ironton	do	Bessemer	do	608, 800
26	Scranton	Minnesota	Hibbing	do	607, 235
27	Susquehanna	do	do	do	606, 124
28	Harrison	do	Pengilly	do	581, 133
29	Witherbee, Sherman & Co. group	New York	Mineville	Magnetite	580, 748
30	Shenango	Minnesota	Chisholm	Hematite	543, 817
31	Hill-Trumbull	do	Marble	do	521, 845
32	Plymouth	Michigan	Wakefield	do	505, 513
33	Bristol (including Youngstown)	do	Crystal Falls	do	501, 115
34	Arcturus	Minnesota	Marble	do	499, 571
35	Raimund Nos. 1 and 2	Alabama	Bessemer	do	489, 941
36	Hawkins	Minnesota	Nashwauk	do	487, 312
37	Penn group	Michigan	Vulcan	do	476, 052
38	Cliffs Shaft	do	Ishpeming	do	466, 254
39	Burt-Pool-Day	Minnesota	Hibbing	do	465, 094
40	Webb	do	do	do	464, 017
41	St. Paul	do	Keewatin	do	455, 240
42	Athens	Michigan	Negaunee	do	449, 891
43	Ogden	do	Ishpeming	do	441, 769
44	Godfrey	Minnesota	Chisholm	do	440, 345
45	Chapin	Michigan	Iron Mountain	do	438, 873
46	Morris-Lloyd	do	Ishpeming	do	435, 430
47	Fayal	Minnesota	Eveleth	do	409, 092
48	Sibley	do	Ely	do	408, 276
49	Corsica	do	Gilbert	do	403, 381
50	Asteroid (including Eureka)	Michigan	Ramsay	do	401, 680
51	Wabigon	Minnesota	Buhl	do	398, 800
52	La Rue	do	Nashwauk	do	390, 035
53	Wacootah	do	Mountain Iron	do	362, 155
54	Wellington	do	Chisholm	do	352, 174
55	Zenith	do	Ely	do	345, 531
56	Puritan	Michigan	Ironwood	do	339, 570
57	Alexandria	Minnesota	Chisholm	do	337, 735
58	Volunteer	Michigan	Palmer	do	335, 963
59	Maas	do	Negaunee	do	331, 922
60	Biwabik	Minnesota	Biwabik	do	330, 363
61	Desert Mound	Utah	Iron Springs	do	320, 960
62	Armour No. 1	Minnesota	Crosby	do	319, 899
63	Albany	do	Hibbing	do	313, 704
64	Danube	do	Bovey	do	302, 621
65	Caspian	Michigan	Iron River	do	299, 343
66	South Agnew	Minnesota	Hibbing	do	288, 212
67	Sargent	do	Keewatin	do	283, 582
68	Harold	do	Stuntz	do	278, 609
69	Lake Superior	Michigan	Ishpeming	do	278, 411
70	Utica	Minnesota	Hibbing	do	271, 088
71	North Harrison	do	Pengilly	do	267, 106
72	Cary	Wisconsin	Hurley	do	266, 033
73	James	Michigan	Iron River	do	260, 841
74	Lincoln	Minnesota	Virginia	do	258, 677
75	Patrick	do	Pengilly	do	254, 794
76	Armour No 2 (including Cuyuna-Duluth).	do	Crosby	do	254, 031
77	Evergreen (including Wearne)	do	do	do	252, 536

Iron-ore mines of the United States that produced more than 100,000 gross tons each in 1929—Continued

Rank	Name of mine	State	Nearest town	Variety of ore	Gross tons
78	Mesabi Chief	Minnesota	Nashwauk	Hematite	248,766
79	Shannon	Alabama	Birmingham	do	240,327
80	Bengal	Michigan	Iron River	do	239,985
81	Riverton group	do	do	do	235,558
82	Berkshire	do	Stambaugh	do	231,778
83	Louise	Minnesota	Ironton	do	228,936
84	Holmes	Michigan	Ishpeming	do	228,565
85	Archibald	do	Gwinn	do	220,821
86	Hoadley	Minnesota	Nashwauk	do	220,712
87	Rogers	Michigan	Iron River	do	220,016
88	Balkan (including Judson)	do	Alpha	do	219,658
89	Kevin	Minnesota	Pengilly	do	218,388
90	Aragon	Michigan	Norway	do	214,112
91	Croft	Minnesota	Crosby	do	211,461
92	Kinney	do	Kinney	do	205,702
93	Orwell	do	Bovey	do	201,894
94	Hiawatha	Michigan	Iron River	do	201,400
95	Margaret	Minnesota	Buhl	do	200,932
96	Davidson No. 1	Michigan	Iron River	do	200,617
97	Bruce	Minnesota	Chisholm	do	198,345
98	Union	do	Virginia	do	190,062
99	Zimmerman	Michigan	Gaastra	do	179,320
100	Warner	do	Amasa	do	178,170
101	Mississippi	Minnesota	Keewatin	do	177,301
102	Union Hill (including Republic)	New Mexico	Fierro	Magnetite	171,585
103	Homer	Michigan	Iron River	Hematite	166,250
104	Virgil	do	do	do	165,163
105	Richmond	do	Palmer	do	164,503
106	Wade	Minnesota	Kinney	do	162,595
107	Cambria (including Lillie)	Michigan	Negaunee	do	161,844
108	Chateaugay	New York	Lyon Mountain.	Magnetite	160.946
109	Palms	Michigan	Bessemer	Hematite	160,515
110	Bates	do	Iron River	do	159,565
111	Buck	do	do	do	156,904
112	Soudan	Minnesota	Soudan	do	155,611
113	Forbes	Michigan	Iron River	do	154,550
114	Tobin	do	Crystal Falls	do	149,900
115	Sauntry	Minnesota	Virginia	do	148,343
116	Mt. Hope	New Jersey	Wharton	Magnetite	147,274
117	Loretto	Michigan	Loretto	Hematite	139,087
118	Iron Mountain	Missouri	Iron Mountain	do	137,181
119	South Uno (G. N.)	Minnesota	Stuntz	do	136,713
120	North Uno (G. N.)	do	Hibbing	do	134,511
121	Maroco	do	Ironton	do	134,032
122	Russellville	Alabama	Russellville	Brown ore	130,144
123	Virginia	Minnesota	Virginia	Hematite	128,519
124	Keweenaw	Michigan	Bessemer	do	123,609
125	Gardner-Mackinaw	do	Gwinn	do	117,224
126	Tilden	do	Bessemer	do	113,600
127	Isabella	do	Palmer	do	112,824
128	West Davis	do	Ironwood	do	103,324
129	York	Minnesota	Nashwauk	do	101,350
130	Mahnomen-Hopkins-Sultana	do	Ironton	do	100,510
	Total (130 mines)				70,732,520
	Output of 23 mines producing between 50,000 and 100,000 tons each				1,606,426
	Output of 58 mines producing less than 50,000 tons each				688,774
	Grand total of United States (211 mines)				73,027,720

STOCKS OF ORE AT MINES

According to the reports of producers, the total quantity of iron ore in stock at the mines at the end of 1929 amounted to 7,067,206 gross tons, compared with 9,190,061 tons at the end of 1928, a decrease of 23 per cent. As the quantity of ore in stock piles is of necessity partly estimated, resulting variations in the mine reports from year to year prevent an absolute balance between the quantity mined, the quantity shipped, and the stocks on hand. The reported stocks at the end of 1929 were lower than in any year in the period 1910 to

1928 and were 3,346,000 tons below the average for the 5-year period 1924 to 1928.

Stocks of iron ore at mines December 31, 1928 and 1929, by States, in gross tons

State	1928	1929	State	1928	1929
Alabama	996, 751	807, 331	North Carolina		100
Iowa	12, 165	12, 165	Pennsylvania	93, 611	32, 719
Michigan	5, 556, 372	4, 267, 279	Virginia	20, 287	20, 055
Minnesota	2, 079, 823	1, 713, 426	Wisconsin	290, 004	127, 794
Missouri	2, 629				
New Jersey	66, 687	62, 173		9, 190, 061	7, 067, 206
New York	71, 732	24, 164			

VALUE OF ORE PER TON

The table that follows gives the average value at the mines of the different classes of iron ore in 1928 and 1929 for each of the producing States or groups of States except where the shippers of a certain variety of ore in a State were less than three and permission was not given to publish the value. These figures are taken directly from statements of the producers and probably represent the commercial selling prices only approximately, as all the reports are not consistent. Some of them evidently include mining costs only; others contain, in addition, the cost of selling and insuring the ore; others include an allowance for a sinking fund; and still others include only the costs charged against the blast furnaces. None of the reports, however, is supposed to include freight charges.

Average value per gross ton of iron ore at mines in the United States, 1928 and 1929

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

State	Hematite		Brown ore		Magnetite	
	1928	1929	1928	1929	1928	1929
Alabama	$1.82	$1.83	$2.38	$2.49		
Georgia			2.87	2.95		
Michigan	2.60	2.83				
Minnesota	2.47	2.62				(1)
Missouri	3.98	3.89		(1)		
Montana			3.60			
New Jersey			(1)	(1)	$3.87	$4.05
New York					3.79	4.50
North Carolina						3.48
Pennsylvania					2.38	2.07
Tennessee	1.94	2.18	2.77	2.56		
Virginia	2.81		3.77	2.72		
Wisconsin	2.65	2.71				
Other States [2]	1.29	1.31	2.49	1.54	2.00	1.98
	2.43	2.59	2.47	2.47	3.04	3.15

[1] Less than three producers; permission to publish not given, therefore value may not be shown.
[2] Colorado, New Mexico, Utah, Washington, and Wyoming.

The following table summarizes the average value of iron ore at the mines from 1916 to 1929. Not until 1917 did the average value rise above $3 a ton, and the average for 1920, $4.11, is the highest on record.

Average value per gross ton of iron ore at mines in the United States, 1916–1929

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

Year	Hematite	Brown ore	Magnetite	Carbonate	General average [1]
1916	$2.32	$2.03	$3.11	$3.00	$2.34
1917	3.12	2.95	4.29	----------	3.15
1918	3.35	3.51	4.60	----------	3.39
1919	3.48	3.63	4.08	----------	3.50
1920	4.09	4.19	4.59	(2)	4.11
1921	3.37	2.63	3.61	(2)	3.37
1922	3.14	2.65	2.37	(2)	3.12
1923	3.46	2.88	3.34	(2)	3.45
1924	2.91	2.75	2.95	(3)	2.91
1925	2.50	2.78	3.07	(3)	2.52
1926	2.49	2.83	3.13	(2)	2.51
1927	2.43	2.62	3.38	(2)	2.47
1928	2.43	2.47	3.04	(2)	2.46
1929	2.59	2.47	3.15	(2)	2.61

[1] Average values in 1889 and 1892-1915 are given in Mineral Resources for 1919 and many earlier volumes.

[2] Sold for paint and not included in shipments of iron ore.

[3] Carbonate of iron, used in making pig iron, was sold by one producer in Ohio in 1924 and 1925; that from Pennsylvania was sold for paint.

IRON ORE CONSUMED

The furnaces in Alabama in making 1 ton of pig iron consumed in 1929 an average of 2.487 tons of ore, the highest average for any State. The greater part of the iron ore used in Alabama furnaces in 1929 was hematite from mines in Jefferson County, Ala.; a small quantity of hematite from Etowah County, Ala., was also used. The brown ore used was obtained chiefly from mines in the Birmingham and Russellville districts, Alabama, and the Cedartown district, Georgia, and the manganiferous iron ore was chiefly from mines in Alabama, Arkansas, Georgia, and Virginia.

In 1929 the furnaces in Maryland used chiefly foreign ores obtained from Algeria, Australia, Chile, Cuba, and Sweden, although some ore from the Lake Superior district was also used. The Maryland furnaces consumed an average of only 1.543 tons of ore in making 1 ton of pig iron in 1929, but they used proportionately more cinder, scale, and scrap than the furnaces in Alabama.

The blast furnaces in Indiana, Kentucky, Michigan, Minnesota, Ohio, and West Virginia used Lake Superior iron ore and manganiferous iron ore exclusively in 1929. The consumption of ores per ton of iron made ranged from 1.401 tons in Kentucky to 1.868 tons in Indiana.

The furnaces in the Chicago district, including Joliet, Ill., used iron ore and manganiferous iron ore from mines in the Lake Superior district; those at Granite City, Ill., used ore chiefly from mines in the Lake Superior district and in addition used ore from the Iron Mountain, Rueppele, Cherry Valley, and Puxico mines in Missouri. An average of 2.002 tons of ore was used to make 1 ton of pig iron in 1929.

In New York the furnaces in the Buffalo district used ores from the Lake Superior district; the furnaces at Port Henry used magnetite from the New Bed, Old Bed, and Harmony mines at Mineville, N. Y.; and the furnace at Standish used magnetite from the Chateaugay mine at Lyon Mountain, N. Y. In making 1 ton of pig iron the furnaces in New York used an average of 1.843 tons of ore in 1929.

The furnaces in western Pennsylvania used ore from the Lake Superior district. Those in the eastern part of the State used, in addition to some Lake ores, magnetite from the Cornwall mine in Pennsylvania; magnetites from the Beach Glen, Cannon and Peters, Mt. Hope, and Richard mines in New Jersey; magnetites from the New Bed, Old Bed, Harmony, No. 21, Chateaugay, and Forest of Dean mines in New York; and considerable quantities of ores from Africa, Brazil, Chile, Cuba, Newfoundland, Spain, and Sweden. An average of 1.677 tons of ore was used in Pennsylvania in 1929 to make 1 ton of pig iron.

The iron furnaces in Tennessee used magnetite from the Cranberry mine in North Carolina; brown ore from Wrigley and Bon Aqua, Tenn.; hematite from the Rockwood area, Tennessee; brown ore from the Bartow and Reed mines in Georgia; manganiferous iron ore from Georgia and Tennessee; and some ore from Algeria and Spain. An average of 1.943 tons of ore was used per ton of iron made in 1929.

Virginia iron furnaces used local hematite, brown ore, and pyrite cinder in 1929. These furnaces used 1.509 tons of cinder, scale, and scrap to 1 ton of pig iron, the highest average for any State. The consumption of ore per ton of iron made was 0.93 ton in 1929.

The blast furnaces at Pueblo, Colo., used brown ore from the Orient mine in Colorado, hematite from the Sunrise mine in Wyoming and from the Desert Mound mine in Utah, magnetite from the Union Hill mine in New Mexico, and manganiferous iron ores from Leadville, Colo., and Silver City, N. Mex.

The blast furnace at Provo, Utah, used iron ore chiefly from the Desert Mound mine in the Iron Springs district, Utah. The manganiferous iron ore used was obtained from California, Idaho, Montana, Nevada, and Utah.

The following two tables show the consumption of iron ore and other metallic materials, the production of pig iron (as reported to the Bureau of Mines), and the average quantities of materials used per ton of pig iron made.

Iron ore and other metallic materials consumed and pig iron produced in 1929, by States, in gross tons

State	Metalliferous materials consumed				Pig iron produced, exclusive of ferro-alloys	Materials consumed per ton of iron made		
	Iron and manganiferous iron ores		Cinder, scale, and scrap	Total		Ores	Cinder, scale, and scrap	Total
	Domestic	Foreign						
Alabama	6,670,045	56,799	168,532	6,895,376	2,704,733	2.487	0.062	2.549
Illinois	8,723,708		620,931	9,344,639	4,358,555	2.002	.142	2.144
Indiana	7,990,567		466,176	8,456,743	4,277,759	1.868	.109	1.977
Kentucky	275,185		75,254	350,439	196,417	1.401	.383	1.784
Maryland	157,305	1,567,272	334,846	2,059,423	1,117,228	1.543	.300	1.843
Michigan	1,310,832		149,882	1,460,714	807,856	1.623	.185	1.808
Minnesota	669,063		78,669	747,732	379,162	1.765	.207	1.972
New York	4,857,993		213,969	5,071,962	2,635,675	1.843	.081	1.924
Ohio	16,480,454		1,735,087	18,215,541	9,708,425	1.697	.179	1.876
Pennsylvania	22,390,443	1,102,134	2,840,112	26,332,689	14,008,831	1.677	.203	1.880
Tennessee	217,555	12,149	15,792	245,496	118,213	1.943	.134	2.077
Virginia	11,082		17,991	29,073	11,921	.930	1.509	2.439
West Virginia	1,190,346		53,017	1,243,363	665,584	1.788	.080	1.868
Undistributed [1]	1,386,348	149,460	47,056	1,582,864	771,129	1.992	.061	2.053
	72,330,926	2,887,814	6,817,314	82,036,054	41,761,488	1.801	.163	1.964

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[1] Includes Colorado, Massachusetts, and Utah.

Iron ore and other metallic materials consumed and pig iron produced in the United States, 1920–1929, in gross tons

Year	Metalliferous materials consumed				Pig iron produced, exclusive of ferro-alloys	Materials consumed per ton of iron made			
	Iron and manganiferous iron ores		Cinder, scale, and scrap	Total		Ores		Cinder, scale, and scrap	Total
	Domestic	Foreign				Domestic	Foreign		
1920	64,671,894	968,313	5,650,128	71,290,335	36,242,748	1.784	0.027	0.156	1.967
1921	28,847,395	372,038	2,269,864	31,489,297	16,403,627	1.759	.023	.138	1.920
1922	46,485,690	910,205	4,285,187	51,681,082	26,826,210	1.733	.034	.160	1.927
1923	69,272,579	2,084,094	5,376,448	76,733,121	39,767,482	1.742	.052	.135	1.929
1924	51,880,562	2,012,689	4,646,320	58,539,571	30,869,199	1.681	.065	.150	1.896
1925	62,029,734	2,337,767	5,137,068	69,504,569	36,124,678	1.717	.065	.142	1.924
1926	65,922,601	2,442,631	6,254,523	74,619,755	38,755,698	1.701	.063	.161	1.925
1927	61,718,383	2,540,558	5,602,006	69,860,947	35,875,129	1.720	.071	.156	1.947
1928	63,795,555	2,625,620	6,026,785	72,447,960	37,410,897	1.706	.070	.161	1.937
1929	72,330,926	2,887,814	6,817,314	82,036,054	41,761,488	1.732	.069	.163	1.964

Foreign iron and manganiferous iron ores consumed in the manufacture of pig iron in the United States, 1928 and 1929, by sources of ore, in gross tons

Source of ore	1928	1929	Source of ore	1928	1929
Africa	385,362	275,432	Newfoundland	51,080	65,581
Asia	1,687	1,943	Spain	39,660	38,011
Australia	13,314	35,536	Sweden	128,889	185,789
Brazil	126	821	Undistributed	70,997	68,948
Chile	1,525,846	1,551,529			
Cuba	408,659	664,224		2,625,620	2,887,814

LAKE SUPERIOR DISTRICT

PRODUCTION

The total quantity of iron ore mined in the Lake Superior district, not including the Iron Ridge area in Wisconsin, increased 20 per cent in 1929. The output of the several ranges is shown in the table that follows. After 1905 the figures do not include manganiferous iron ore containing 5 per cent or more of manganese; 1,058,953 gross tons of this ore was mined in 1929, compared with 1,077,705 tons in 1928. The Mesabi range produced 67 per cent of the iron-ore output of the Lake Superior district and 58 per cent of the total output of the United States in 1929. The proportion contributed by this range has been remarkably uniform since 1915, but was slightly more than the average in 1929. Production on each of the iron ranges increased in 1929; the per cent of increase on the Cuyuna range was the largest, and that on the Gogebic range was the smallest. The production on the Mesabi range in 1929 was the largest on record, exceeding by 1.3 per per cent the output in the previous record year (1923).

Iron ore mined in the Lake Superior district, 1854–1929, in gross tons

[Exclusive after 1905 of ore containing 5 per cent or more of manganese]

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1854–1870	3, 971, 716	------------	------------	------------	------------	------------	3, 971, 716
1871–1880	10, 294, 047	858, 810	------------	------------	------------	------------	11, 152, 857
1881–1890	18, 598, 012	11, 917, 416	8, 657, 807	3, 260, 426	------------	------------	42, 433, 661
1891–1900	27, 269, 545	21, 639, 872	23, 361, 043	12, 097, 048	32, 282, 873	------------	116, 650, 381
1901–1910	37, 728, 143	41, 974, 789	34, 514, 899	15, 350, 581	194, 654, 902	------------	324, 223, 314
1911–1915	18, 404, 620	21, 862, 454	21, 366, 821	7, 234, 387	142, 721, 213	3, 191, 627	214, 781, 122
1916	4, 792, 987	6, 649, 578	7, 707, 101	1, 704, 440	41, 325, 341	1, 555, 641	63, 735, 088
1917	4, 638, 374	6, 366, 483	7, 881, 232	1, 481, 301	41, 127, 323	1, 986, 608	63, 481, 321
1918	3, 946, 554	6, 041, 637	7, 837, 634	1, 192, 677	39, 055, 977	1, 705, 315	59, 779, 794
1919	4, 158, 751	4, 863, 968	7, 368, 994	1, 051, 795	33, 262, 954	1, 685, 877	52, 392, 339
1920	4, 457, 609	5, 651, 542	8, 298, 206	1, 053, 518	36, 641, 880	1, 757, 775	57, 860, 530
1921	2, 204, 114	2, 147, 569	3, 135, 477	981, 576	16, 380, 190	449, 559	25, 298, 485
1922	2, 745, 626	3, 290, 641	4, 910, 789	1, 108, 764	26, 704, 601	955, 595	39, 716, 016
1923	3, 910, 909	4, 913, 541	6, 112, 662	1, 119, 113	41, 809, 018	1, 420, 165	59, 285, 408
1924	3, 579, 087	3, 780, 664	5, 579, 883	1, 141, 690	29, 818, 965	941, 430	44, 841, 719
1925	3, 813, 687	5, 009, 022	6, 377, 710	1, 331, 753	34, 851, 109	673, 382	52, 056, 663
1926	4, 046, 191	5, 445, 683	6, 949, 920	1, 568, 953	37, 997, 797	1, 134, 863	57, 143, 407
1927	4, 015, 730	5, 458, 182	6, 604, 830	1, 577, 817	32, 866, 034	1, 017, 287	51, 539, 880
1928	3, 755, 343	4, 855, 735	6, 342, 092	1, 628, 289	34, 856, 333	1, 079, 383	52, 517, 175
1929	4, 545, 839	5, 428, 469	7, 089, 602	1, 883, 547	42, 371, 192	1, 506, 119	62, 824, 768
	170, 876, 884	168, 156, 055	180, 096, 702	56, 767, 675	858, 727, 702	21, 060, 626	1, 455, 685, 644

SHIPMENTS AND RECEIPTS

According to the Lake Superior Iron Ore Association, a total of 66,157,359 gross tons of iron ore and manganiferous iron ore was shipped in 1929 from the Lake Superior district, including the Iron Ridge area in Wisconsin, as compared with 54,855,641 tons in 1928. The shipments as reported to the Bureau of Mines by producers amounted to 65,101,561 gross tons of iron ore and 1,058,953 tons of manganiferous iron ore containing 5 per cent or more of manganese, a total of 66,160,514 tons in 1929, as compared with 53,768,733 tons of iron ore and 1,077,705 tons of manganiferous iron ore, a total of 54,846,438 tons in 1928.

The iron ore received at Lake Erie ports, according to the Lake Superior Iron Ore Association, amounted to 45,772,572 gross tons and at other than Lake Erie ports to 18,779,099 gross tons, a total of 64,551,671 tons in 1929, compared with 36,956,342 tons at Lake Erie ports and 16,484,805 tons at other than Lake Erie ports, a total of 53,441,147 tons in 1928.

STOCKS OF ORE AT LAKE ERIE PORTS

Stocks of iron ore at lower Lake ports at the end of the shipping season are important because of their bearing on the manufacture of pig iron during the following winter and spring. According to the Lake Superior Iron Ore Association, at the close of navigation in 1929, 6,489,612 gross tons of ore was in stock at Lake Erie ports, compared with 6,454,126 tons on the corresponding date in 1928. At the opening of navigation in May, 1930, 4,334,929 tons of ore was in stock at these ports, indicating a withdrawal of 2,154,683 tons during the winter of 1929–30. The average quantity withdrawn each winter during the preceding five winters was about 2,911,000 tons.

PRICES OF LAKE SUPERIOR ORE

The price of iron ore per unit of iron in the natural state for the four standard grades of Lake Superior ore for the last 16 years is shown in the Iron Trade Review.[5] The base of Bessemer ore, old-range and Mesabi, for 1925 to 1929 is a metallic iron content of 51.5 per cent, natural, instead of 55 per cent as for 1924 and many earlier years. The base of non-Bessemer ore, old-range and Mesabi, remains as heretofore at 51.5 per cent, natural. The unit prices established March 22, 1929, are slightly above those obtaining in 1925 to 1928 and are as follows: Old-range Bessemer, 9.32 cents; Mesabi Bessemer, 9.029 cents; old-range non-Bessemer, 9.029 cents; and Mesabi non-Bessemer, 8.738 cents. The prices per ton that correspond to these unit prices are, respectively, $4.80, $4.65, $4.65, and $4.50, or 25 cents per ton above those in 1928. The lowest prices ever quoted for these ores were $2.60 for old-range Bessemer in 1897, $2.15 for Mesabi Bessemer in 1895, $1.85 for old-range non-Bessemer in 1898, and $1.75 for Mesabi non-Bessemer in 1898.

IRON-ORE RESERVES

Estimates of ore reserves for Minnesota, furnished by the Minnesota Tax Commission, and for Michigan, furnished by the Michigan Board of State Tax Commissioners, cover developed and prospective ore in the ground and ore in stock piles. These estimates show decreases from the previous year of about 16,173,000 gross tons in Minnesota and about 1,081,000 tons in Michigan.

Iron-ore reserves in Minnesota May 1, 1925–1929, in gross tons

Range	1925	1926	1927	1928	1929
Mesabi	1, 250, 086, 347	1, 233, 979, 351	1, 201, 054, 119	1, 190, 480, 901	1, 178, 855, 601
Vermilion	13, 539, 256	12, 382, 725	12, 126, 490	14, 483, 285	14, 939, 704
Cuyuna	52, 124, 561	51, 090, 529	49, 652, 592	53, 268, 438	48, 264, 579
	1, 315, 750, 164	1, 297, 452, 605	1, 262, 833, 201	1, 258, 232, 624	1, 242, 059, 884

Iron-ore reserves in Michigan January 1, 1926–1930, in gross tons

Range	1926	1927	1928	1929	1930
Gogebic	52, 131, 121	53, 342, 720	48, 681, 075	48, 587, 126	51, 347, 176
Marquette	67, 160, 777	63, 612, 812	60, 219, 781	57, 920, 862	55, 655, 383
Menominee (including Iron River and Crystal Falls districts)	69, 188, 118	67, 103, 492	64, 752, 677	62, 922, 419	61, 347, 264
	188, 480, 016	184, 059, 024	173, 653, 533	169, 430, 407	168, 349, 823

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[5] Iron Trade Review: Vol. 84, Mar. 28, 1929, p. 889.

IRON-ORE MINING, BY STATES

LAKE SUPERIOR DISTRICT

The outstanding features of mining developments in the Lake Superior iron mining district are described in articles published in trade and mining journals.[6]

Michigan.—Mining activity on the Michigan iron ranges in 1929 was on a considerably increased scale, as is shown by a production of 15,456,397 gross tons, compared with 13,676,984 tons in 1928. The production in 1929 was made by 58 mines in five counties, as the following table shows.

Iron ore mined in Michigan, 1928 and 1929, by counties

County	1928		1929	
	Active mines	Gross tons	Active mines	Gross tons
Baraga	1	89, 996	1	91, 374
Dickinson	5	1, 181, 724	5	1, 289, 150
Gogebic	17	5, 065, 906	17	5, 553, 199
Iron	23	3, 674, 011	20	4, 068, 209
Marquette	18	3, 665, 347	15	4, 454, 465
	64	13, 676, 984	58	15, 456, 397

The ore reserves in Michigan on January 1, 1930, amounted to 168,349,823 gross tons, a decrease from the previous year of about 1,081,000 tons—evidence that new discoveries did not quite keep pace with production.

Only one mine in Michigan, the Norrie-Aurora mine in Gogebic County, produced more than 1,000,000 tons in 1929. Of the 58 active mines in Michigan in 1929, 48 yielded more than 100,000 tons each. The average production per mine in Michigan in 1929 was 266,490 tons, compared with 213,703 tons in 1928.

A report on the iron-ore mines of Michigan for 1929, published by the geological survey division of the Michigan Department of Conservation,[7] shows that the average number of men employed per day was 8,996, the average number of days worked underground and in open pits was 284, the average daily wage was $4.915, the average yearly earning was $1,395.77, and the tons of ore mined per man per day was 5.84.

The following table on average per ton costs of mining iron ore at underground mines and at siliceous open pits has been condensed from statistics published in much greater detail by the geological survey division of the Michigan Department of Conservation.

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[6] Hain, A. J., Iron Ore Industry Speeds Up: Iron Trade Rev., vol. 86, Jan. 2, 1930, pp. 32–35, 69; Skillings' Mining Rev. (various issues).

[7] Pardee, F. G., and Osgood, W., General Statistics Covering Costs and Production of Michigan Iron Mines: Geological Survey Division, Department of Conservation (Lansing), 1930.

Average per ton costs of mining iron ore at underground mines and at siliceous open pits in Michigan in 1929

Item	Underground					Siliceous open pits
	Dickinson	Gogebic	Iron	Marquette	Total	
Cost of mining	$1.8110	$1.4983	$1.2415	$1.6124	$1.4761	$0.4003
Deferred mining costs	.0289	.1192	.0746	.0927	.0898	.0334
Taxes	.2109	.2915	.1751	.2501	.2366	.0418
General overhead	.1444	.1953	.2027	.2736	.2123	.1545
Transportation	1.4483	1.6577	1.4575	1.3911	1.5146	1.3940
Marketing	.0469	.0276	.0768	.0952	.0640	.0984
Total ore cost	3.6904	3.7896	3.2282	3.7151	3.5934	2.1224
Lake Erie value per ton	4.5613	4.6006	4.3000	4.8394	4.5838	2.2849
Gross ore profit [1]	.8709	.8110	1.0718	1.1243	.9904	.1625

[1] This figure does not represent true profit, as much ore is sold at a discount.

The mining methods used in a mine producing soft hematite on the Marquette range[8] and in one producing soft hematite on the Menominee range[9] are described by Eaton, who also gives detailed figures on the cost of mining the ore.

Minnesota.—Mining activities in Minnesota were on a record scale in 1929, the production of 45,760,858 gross tons representing an increase of 22 per cent over 1928 and exceeding by 2.6 per cent the previous peak year (1917). The output in 1929 was made by 85 mines in three counties, as shown by the following table:

Iron ore mined in Minnesota, 1928 and 1929, by counties

County	1928		1929	
	Active mines	Gross tons	Active mines	Gross tons
Crow Wing	8	1,079,383	9	1,506,119
Itasca	19	6,919,959	22	8,243,618
St. Louis	57	29,564,663	54	36,011,121
	84	37,564,005	85	45,760,858

The reserves of ore in Minnesota on May 1, 1929, amounted to 1,242,059,884 gross tons, a decrease of 16,172,740 tons from the previous year, indicating that new ore discovered during the year apparently was not enough to keep pace with production.

The largest producing mine in Minnesota, as well as in the United States, in 1929 was the Missabe Mountain, an open-pit operation in St. Louis County, which yielded 6,252,287 gross tons, a record for this mine. The Sellers and Mahoning mines, also open-pit operations in St. Louis County, yielded 5,031,846 tons and 4,041,001 tons, respectively, in 1929, also the record output for each of these mines. The Hull-Rust mine, which for many years was world famed as the largest producer and which has yielded nearly 98,000,000 gross tons, dropped to fifth place in 1928 and was again fifth in 1929 with an output of 2,559,412 tons. Of the 85 active mines in Minnesota in 1929, 66 yielded more than 100,000 tons each. The average production per mine in Minnesota in 1929 was 538,363 tons, compared with 447,191 tons in 1928.

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[8] Eaton, Lucien, Mining Soft Hematite at Mine No. 2 of the Marquette Range, Michigan: Inf. Circ. 6179, Bureau of Mines, October, 1929, 15 pp.

[9] Eaton, Lucien, Mining Soft Hematite by Open Stopes at Mine No. 1, Menominee Range, Michigan: Inf. Circ. 6180, Bureau of Mines, October, 1929, 10 pp.

According to the annual report of the mine inspector of St. Louis County, an average of 8,008 men was employed during 1929 in St. Louis County and the average daily wage was $5.33. As the total production of iron ore in St. Louis County in 1929 was 36,011,121 tons, an average production of nearly 4,500 tons per man is indicated for the year.

Wisconsin.—The production of iron ore in Wisconsin in 1929 was 1,608,571 gross tons, an increase of 25 per cent over 1928. This output was made by four mines in three counties, as shown by the following table:

Iron ore mined in Wisconsin, 1928 and 1929, by counties

County	1928		1929	
	Active mines	Gross tons	Active mines	Gross tons
Dodge	2	8,406	1	1,058
Florence			1	71,110
Iron	4	1,276,186	[1] 2	1,536,403
	6	1,284,592	[1] 4	1,608,571

[1] Apparent decrease due to change in method of counting mines in Iron County.

The chief producing mine in Wisconsin in 1929, as for many years past, was the Montreal mine in Iron County, which yielded 1,270,370 gross tons.

Iron-ore analyses.—The iron content of the ore shipped from the Lake Superior district in 1929 averaged 51.18 per cent, natural, compared with 51.15 per cent in 1928, showing how closely these ores are graded. The average iron contents in 1928 and 1929, however, are the lowest since 1902, the year in which average analyses were first compiled. The percentages of manganese and moisture decreased slightly, and the percentages of silica and phosphorus increased.

The following table, compiled by the Lake Superior Iron Ore Association, summarizes the average analyses of the total tonnages of all grades of ore shipped and shows the remarkable uniformity maintained during the last 10 years.

Average analyses of total tonnages of all grades of iron ore from all ranges of Lake Superior district, 1920–1929

Year	Gross tons	Fe (natural)	P	SiO_2	Mn	Moisture
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1920	57,938,428	51.69	0.103	8.13	0.77	11.09
1921	22,523,989	52.07	.087	8.23	.62	10.95
1922	43,431,294	51.87	.099	8.23	.76	10.78
1923	60,024,176	51.79	.095	8.22	.79	10.76
1924	43,276,165	51.72	.100	8.45	.76	10.75
1925	54,784,355	51.74	.099	8.42	.82	10.58
1926	59,151,368	51.75	.101	8.35	.80	10.78
1927	51,730,711	51.19	.105	8.60	.84	11.31
1928	54,045,941	51.15	.099	8.43	.85	11.37
1929	65,443,546	51.18	.100	8.48	.80	11.24

During this 10-year period the iron content ranged from 51.15 to 52.07 per cent, the phosphorus from 0.087 to 0.105 per cent, the silica from 8.13 to 8.6 per cent, the manganese from 0.62 to 0.85 per cent, and the moisture from 10.58 to 11.37 per cent. This uniformity does not, of course, indicate that the average grade of the available Lake Superior iron ore is not declining. The grade of shipments has been maintained by methods of beneficiation, which are ever becoming more elaborate, and by mixing ores from different deposits.

SOUTHEASTERN STATES

Alabama.—The production of iron ore in Alabama in 1929 amounted to 6,453,075 gross tons, an increase of 2 per cent over 1928. This output was made by 28 mines in nine counties, as the following table shows:

Iron ore mined in Alabama, 1928 and 1929, by counties

County	1928		1929	
	Active mines	Gross tons	Active mines	Gross tons
Blount	5	247, 255	5	228, 064
Etowah	1	10, 472	1	12, 769
Franklin	1	104, 858	2	143, 374
Jefferson	6	5, 658, 021	6	5, 814, 143
Tuscaloosa	5	261, 918	4	239, 358
Calhoun	2	25, 320	3	2, 581
Cherokee	3		4	5, 556
Talladega	1		2	7, 230
Butler	-------	------------	1	
	24	6, 307, 844	28	6, 453, 075

The ore produced in Blount County in 1929 was brown ore, all of which was washed; the iron content of the concentrates averaged 47.5 per cent, natural, the manganese averaged 0.71 per cent, and the phosphorus averaged 0.28 per cent. The ore produced in Talladega County averaged about 51 per cent of iron, dried. The brown ore concentrates from the Russellville district in Franklin County averaged 49.79 per cent of iron, dried. Tuscaloosa County was the largest producer of brown ore in Alabama in 1929; the iron content (natural) of the concentrates ranged from 38.88 to 45.6 per cent and averaged 44.29 per cent. The ore produced in Calhoun County in 1929 averaged 48.51 per cent of iron, that produced in Cherokee County averaged 47.3 per cent of iron, and that produced in Butler County averaged 56.83 per cent of iron.

Most of the ore mined in Alabama is hematite, much of which is self-fluxing or nearly so. Jefferson County is the chief producer of hematite; the iron content of that shipped in 1929 ranged from 33.3 to 37.78 per cent, natural, and averaged 36.66 per cent. The hematite mined in Etowah County in 1929 averaged 52.32 per cent of iron, natural.

Georgia.—The production of iron ore in Georgia in 1929 was 59,316 gross tons, a decrease of 19 per cent from 1928. This output was made by six mines in two counties, as shown by the following table:

Iron ore mined in Georgia, 1928 and 1929, by counties

County	1928		1929	
	Active mines	Gross tons	Active mines	Gross tons
Bartow	1	11,130	1	8,725
Polk	3	61,922	5	50,591
	4	73,052	6	59,316

All the ore from Georgia in 1929 was brown ore; the iron content averaged about 50 per cent. Most of this ore was mined from the Cedartown area in Polk County; the remainder was from the Cartersville district in Bartow County.

Tennessee.—Tennessee yielded both hematite and brown ore in 1929; the total mined was 102,171 gross tons, a decrease of 21 per cent from 1928. This output was made by five mines in four counties, as shown by the following table:

Iron ore mined in Tennessee, 1928 and 1929, by counties

County	1928		1929	
	Active mines	Gross tons	Active mines	Gross tons
Dickson	2	8,898	2	8,880
Hickman	1	23,095	1	24,536
Lawrence	1	13,273	-------	------------
Hamilton	1	83,662	1	68,755
Roane	1		1	
	6	128,928	5	102,171

By far the greater part of the ore is hematite, mined near Rockwood, Roane County. The iron content of the Rockwood ore averaged 34 per cent, natural, in 1929. The brown ore mined in 1929 was chiefly from the Johnson mine in Hickman County and the Iron Hill mine in Dickson County. The brown ore from these mines is hand picked, washed, and jigged, and the iron content of the concentrates recovered in 1929 averaged 50 and 48 per cent, respectively. A small quantity of hematite used for paint was mined at a deposit near Ooltewah, Hamilton County, in 1929.

In 1929, 121,851 gross tons of iron sinter, recovered from copper sulphide ore mined in Polk County, was shipped; the sinter shipped in 1929 averaged 64.26 per cent of iron, 0.143 per cent of manganese, and 0.006 per cent of phosphorus. These shipments are not included in the statistics of iron ore.

Virginia.—No iron ore was produced in Virginia in 1929, but 232 gross tons of ore from stock pile at the Oriskany mine in Botetourt County was shipped.

MISSOURI

The output of iron ore in Missouri in 1929 amounted to 168,934 gross tons, an increase of 78 per cent over 1928. The output in 1929 consisted of 167,301 tons of hematite and 1,633 tons of brown ore. The hematite was mined at the Rueppele mine in Franklin County, the Iron Mountain mine in St. Francois County, and the Cherry Valley mine in Crawford County; the iron content, dried, ranged from 50.15 to 58 per cent and averaged 51.56 per cent. The brown ore was mined at the Puxico mine in Stoddard County. Most of the ore from these mines in 1929 was shipped to the blast furnaces at Granite City, Ill. The Missouri production, however, was only about one-fourth of the ore requirements of these furnaces, the larger part of the ore they consumed being obtained from the Lake Superior district.

NORTHEASTERN STATES

New Jersey.—The production of iron ore in New Jersey in 1929 was 281,327 gross tons, an increase of 12 per cent over 1928. The Mt. Hope mine, near Wharton, Morris County, with an output of 147,274 tons of concentrates, was again the largest producer; the iron content of the magnetite concentrates shipped averaged 61.01 per cent. The Richard mine, also near Wharton, Morris County, produced 63,847 tons of magnetite concentrates and 146 tons of lump ore; the concentrates shipped averaged 62.2 per cent of iron. The Cannon and Peters mines, near Ringwood Manor, Passaic County, and the Beach Glen mine, near Rockaway, Morris County, were also worked in 1929; the concentrates shipped from the Cannon and Peters mines averaged 64.02 per cent of iron and the concentrates from the Beach Glen mine averaged 62 per cent. Some ore from stock pile at the Ahles mine, near Buttzville, Warren County, was sold for use in gas purification and in the manufacture of paint.

New York.—The production of iron ore in New York in 1929, amounting to 822,261 gross tons, was 15 per cent more than that in 1928. Operations at the Harmony, New Bed, and Old Bed mines at Mineville, in Essex County, were on a slightly decreased scale in 1929; the mines were the largest producers of magnetite in the State. The product shipped in 1929 consisted of 280,353 tons of sinter averaging 63.4 per cent of iron, 264,685 tons of concentrates averaging 67.1 per cent of iron, and 85,981 tons of lump ore averaging 62.9 per cent of iron. The Chateaugay mine in Clinton County was worked on a greatly increased scale in 1929; all the ore from this mine is sintered; the sinter shipped in 1929 averaged 65.5 per cent of iron and 0.005 per cent of phosphorus. The Forest of Dean mine in Orange County yielded about 65 per cent more magnetite concentrates in 1929 than in 1928; the concentrates shipped in 1929 averaged about 62 per cent of iron. The No. 21 mine in Essex County was nonproductive again in 1929, but some ore was shipped from stock pile. New York is the largest producer of iron ore for use in paint. The ore, known as Clinton hematite, was mined in 1929 in Oneida and Wayne Counties.

Pennsylvania.—Pennsylvania, the largest producer of magnetite in the United States, yielded 1,092,013 gross tons of ore in 1929, an increase of 7 per cent over 1928. The magnetite shipped in 1929 averaged 39.5 per cent of iron, natural. Some carbonate ore for use in paint was mined in Carbon County in 1929.

WESTERN STATES

California.—A small quantity of brown ore, sold for use in the manufacture of paint, was mined near Oakland, in Alameda County, in 1929.

Colorado.—The production of brown iron ore in Colorado in 1929 was 50,754 gross tons, a decrease of 4 per cent from 1928. This ore was mined at the Orient mine in Saguache County and averaged, natural, 43.36 per cent of iron and 1.39 per cent of manganese.

Nevada.—A small quantity of brown ore, sold for use in the manufacture of paint, was mined near Montello, in Elko County, in 1929.

New Mexico.—The production of iron ore, all magnetite, in New Mexico in 1929 was 171,585 gross tons, 7 per cent less than that in 1928. The ore mined in New Mexico in 1929 was from the Union Hill mine near Fierro, Grant County, and averaged, natural, 50.71 per cent of iron, 0.72 per cent of manganese, and 0.058 per cent of phosphorus.

Utah.—The production of iron ore in Utah in 1929, amounting to 324,885 gross tons, was 1.3 per cent more than that in 1928. The ore produced in Utah in 1929 was chiefly hematite from the Desert Mound mine, near Iron Springs, Iron County; it averaged, natural, 51.68 per cent of iron, 2.3 per cent of manganese, and 0.29 per cent of phosphorus. The only other active mine in Utah in 1929 was the Iron King mine, near Eureka, from which a small quantity of iron ore was mined and shipped.

Washington.—The Big Iron mine in Stevens County was the only active mine in Washington in 1929. The ore is magnetite and is used in making ferromagnesite.

Wyoming.—The production of iron ore in Wyoming in 1929 amounted to 639,477 gross tons, an increase of 30 per cent over 1928. The output was from the Sunrise mine in Platte County. The ore is hematite; that shipped in 1929 averaged, natural, 53.48 per cent of iron and 0.17 per cent of manganese.

FOREIGN TRADE IN IRON ORE

IMPORTS AND EXPORTS

The iron ore imported into the United States in 1929 amounted to 3,139,334 gross tons, valued at $8,145,354, or $2.59 a ton, as compared with 2,452,646 tons, valued at $5,428,019, or $2.21 a ton, in 1928. These figures represent increases of 28 per cent in quantity and 50 per cent in total value as compared with 1928. The imports of iron ore in 1929 are the largest ever recorded. Africa, Chile, Cuba, and Sweden were the chief sources of imports in 1929; these four sources furnished 90 per cent of the total. The other main sources of imported ore in 1929 were Australia, Brazil, Egypt, Newfoundland and Labrador, and Spain; 9 per cent of the total came from these countries.

Iron ore imported into the United States, 1927–1929, by countries

Country	1927		1928		1929	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Africa:						
British West	1,860	$23,715				
French—						
Algeria and Tunisia	445,070	1,419,410	459,860	$1,550,643	171,995	$570,852
Other	1,350	17,955				
Australia	5,000	14,381	18,115	58,516	41,798	132,161
Brazil	8,905	69,261	31,805	229,159	46,050	259,367
Canada	26,079	96,392	13,309	44,623	3,542	14,502
Chile	1,369,200	1,560,764	1,434,860	1,579,119	1,699,066	2,462,738
Costa Rica			(1)	10		
Cuba	392,113	1,499,020	369,286	1,416,561	641,350	2,334,635
Egypt	10,420	28,141	14,080	89,964	77,690	471,077
France			30	206		
Germany	2,274	8,369	2,523	8,384	545	1,656
Greece					12,750	52,362
India, British					8,000	27,239
Italy	7,700	10,305				
Jamaica			81	1,620		
Japan			6	133		
Netherlands	538	1,881				
Newfoundland and Labrador	61,030	240,199	37,048	144,595	76,340	317,294
Norway	16,608	70,720				
Persia			1,750	31,936		
Soviet Russia in Europe			(1)	2		
Spain	27,165	72,701	37,420	134,113	48,885	262,326
Sweden	244,458	912,341	26,558	107,773	310,406	1,221,508
United Kingdom	947	22,728	5,915	30,662	916	17,618
Venezuela					1	19
	2,620,717	6,068,283	2,452,646	5,428,019	3,139,334	8,145,354

[1] Less than 1 ton.

Iron ore imported into the United States, 1872–1929, in gross tons

1872–1880	1,188,267	1922	1,135,156
1881–1890	7,663,630	1923	2,768,430
1891–1900	5,869,757	1924	2,047,055
1901–1910	11,798,568	1925	2,190,697
1911–1915	9,202,947	1926	2,555,441
1916	1,325,736	1927	2,620,717
1917	971,663	1928	2,452,646
1918	787,468	1929	3,139,334
1919	476,461		
1920	1,273,456		59,783,197
1921	315,768		

Exports of iron ore from the United States in 1929 amounted to 1,304,417 gross tons, valued at $4,774,842, or $3.66 a ton, as compared with 1,282,306 tons, valued at $4,797,881, or $3.74 a ton, in 1928. These figures represent an increase in 1929 of 1.7 per cent in quantity but a decrease of 0.5 per cent in total value. The exports of iron ore in 1929 are also the largest ever recorded. Of the ore exported in 1929 more than 99 per cent went to Canada.

Iron ore exported from the United States, 1928 and 1929, by countries

Country	1928		1929	
	Gross tons	Value	Gross tons	Value
Canada	1,250,206	$4,656,611	1,295,178	$4,741,457
China			25	120
Cuba			27	732
Sweden			1	15
United Kingdom	32,100	141,270	9,186	32,518
	1,282,306	4,797,881	1,304,417	4,774,842

Iron ore exported from the United States, 1899–1929, in gross tons

1899–1900	92, 125	1923	1, 116, 932
1901–1910	2, 713, 397	1924	595, 413
1911–1915	4, 265, 538	1925	630, 521
1916	1, 183, 952	1926	868, 710
1917	1, 132, 313	1927	898, 793
1918	1, 256, 383	1928	1, 282, 306
1919	996, 569	1929	1, 304, 417
1920	1, 145, 037		
1921	440, 106		20, 524, 706
1922	602, 194		

IRON-ORE MINING IN CUBA

The iron ore shipped from Cuba to the United States in 1929 amounted to 671,320 gross tons, as compared with 394,420 tons in 1928, an increase of 70 per cent. The shipments in 1929 were 89.6 per cent of hematite, including a little magnetite, from the Daiquiri and Juragua mines on the southern coast and 10.4 per cent of brown ore from the Mayari mines, near the northern coast. In 1929 the hematite, dried at 212° F., contained 56.31 per cent of iron, whereas the brown ore, nodulized, carried 55.49 per cent. In 1928 the hematite, dried, averaged 55.32 per cent, whereas the brown ore, nodulized, averaged 54.86 per cent.

The total stock of ore, natural and nodulized, reported on hand at the end of 1929 was 384,547 gross tons, compared with 822,200 tons at the end of 1928, a decrease of 53 per cent.

The following table shows the shipments of iron ore from Cuba since the opening of the mines in 1884. The statistics of the shipments of Cuban iron ore are collected by the Bureau of Mines.

Iron ore shipped from mines in the Province of Oriente, Cuba, 1884–1929, in gross tons

Year	Juragua (hematite and magnetite)	Daiquiri (hematite and a little magnetite)	Sigua (hematite)	Mayari (brown ore)	Guamá (hematite)	El Cuero (hematite)	Total
1884–1890	1, 142, 519	----------	----------	----------	----------	----------	1, 142, 519
1891–1900	[1] 2, 348, 473	[2] 979, 992	20, 438	----------	----------	----------	3, 348, 903
1901–1910	2, 104, 186	[3] 4, 456, 440	----------	307, 700	41, 241	224, 729	7, 134, 296
1911–1915	1, 567, 112	1, 837, 669	----------	1, 855, 525	----------	532, 194	5, 792, 500
1916	212, 013	181, 602	----------	258, 451	----------	60, 650	712, 716
1917	39, 784	181, 028	----------	287, 904	----------	44, 769	553, 485
1918	17, 128	353, 103	----------	232, 540	----------	40, 761	643, 532
1919	----------	279, 700	----------	78, 080	----------	----------	357, 780
1920	561, 268		----------	321, 515	----------	----------	882, 783
1921	130, 359		----------	----------	----------	----------	130, 359
1922	444, 794		----------	----------	----------	----------	444, 794
1923	674, 371		----------	----------	----------	----------	674, 371
1924	283, 094		----------	11, 461	----------	----------	294, 555
1925	514, 040		----------	44, 127	----------	----------	558, 167
1926	528, 647		----------	49, 444	----------	----------	578, 091
1927	348, 607		----------	66, 240	----------	----------	414, 847
1928	340, 404		----------	54, 016	----------	----------	394, 420
1929	601, 322		----------	69, 998	----------	----------	671, 320
	20, 127, 655		20, 438	3, 637, 001	41, 241	903, 103	24, 729, 438

[1] Of this quantity, 5,932 tons was sent to Pictou, Nova Scotia.

[2] Of this quantity, 51,537 tons was sent to ports outside of the United States.

[3] Of this quantity, 12,691 tons was sent to ports outside of the United States.

WORLD PRODUCTION OF IRON ORE, BY COUNTRIES

The following table shows the production of iron ore by countries for 1925 to 1929, so far as figures are obtainable. Figures for preceding years appear in earlier volumes of Mineral Resources. Complete returns for 1929 are not available, but those for 1928 and earlier years are fairly complete. Thus, the figures for 1928 indicate a total world production of about 173,000,000 metric tons, of which the United States furnished about 36 per cent. In 1927 the United States contributed about 37 per cent of the world total, which apparently was about 172,000,000 metric tons.

Iron ore produced, 1925–1929, by countries, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1925	1926	1927	1928	1929
North America:					
Cuba [1]	567,126	587,369	421,505	400,750	682,095
Mexico	127,492	92,982	64,000	80,293	(2)
Newfoundland [3]	1,150,169	879,603	1,356,851	1,572,725	1,541,334
United States	62,901,620	68,708,349	62,732,045	63,195,351	74,199,815
South America:					
Brazil [4]	30,000	30,000	30,000	30,000	30,000
Chile [5]	1,350,834	1,476,355	1,516,440	1,515,203	1,812,343
Europe:					
Austria	1,030,364	1,094,372	1,598,570	1,928,182	1,891,381
Belgium	165,650	144,980	180,890	164,420	(2)
Czechoslovakia	1,229,954	1,421,174	1,590,527	1,779,176	1,807,663
Finland	226	----------	----------	----------	----------
France	35,597,704	39,317,700	45,670,920	49,327,839	51,028,000
Germany [6]	5,742,542	4,594,937	6,315,186	6,296,261	(2)
Greece	88,216	126,624	123,865	166,868	(2)
Hungary	68,517	132,309	194,400	199,547	251,860
Italy	495,905	504,556	503,290	625,488	866,480
Luxemburg	6,672,092	7,756,240	7,266,249	7,026,832	7,571,206
Netherlands	----------	----------	1,000	1,100	(2)
Norway	425,424	212,661	479,334	662,708	650,000
Poland	214,062	316,847	546,370	736,755	659,207
Portugal	2,000	1,640	7,600	14,000	(2)
Rumania	107,384	102,799	97,138	83,869	(2)
Russia [7]	2,201,706	3,415,278	4,791,530	[8] 6,030,100	[8] 7,100,000
Spain	4,442,872	3,181,589	4,960,394	5,771,207	6,546,648
Sweden	8,168,546	8,465,914	9,660,977	4,668,801	11,000,000
Switzerland [9]	59,513	49,995	81,661	65,702	(2)
United Kingdom—					
Great Britain [10]	10,305,671	4,160,101	11,386,467	11,443,083	13,427,043
Northern Ireland	3,498	(2)	5,303	819	(2)
Yugoslavia	139,137	366,624	336,099	439,481	427,946
Asia:					
China	1,519,000	[4] 1,700,000	1,710,135	[4] 1,000,000	[4] 1,000,000
Chosen	351,444	351,575	483,996	504,375	551,814
India, British	1,569,368	1,685,927	1,876,375	2,088,979	(2)
Japan	75,765	130,420	159,005	(2)	(2)
Russia [7]	22,752	15,154	21,476	(8)	(8)
Unfederated Malay States—Johore	276,358	254,100	416,548	654,981	755,138
Africa:					
Algeria	1,780,842	1,629,425	2,004,189	1,985,626	2,196,182
Belgian Congo	87,258	113,511	78,000	51,000	50,000
Madagascar	6	1	(11)	----------	----------
Morocco—					
French	----------	----------	1,050	(2)	(2)
Spanish	800,000	[9] 467,350	[9] 997,111	[9] 1,060,709	[9] 1,061,424
Rhodesia—					
Northern	----------	----------	3,474	4,538	3,613
Southern	1,063	1,923	477	3,112	3,406
South-West Africa	14,161	17,869	21,753	29,929	28,697
Tunisia	724,000	582,000	915,000	909,000	977,000
Union of South Africa [1]	----------	47,200	77,523	20,898	38,270
Oceania:					
Australia—					
New South Wales [12]	157,735	159,788	182,999	85,558	(2)
Queensland	351	4,483	515	----------	1,256
South Australia	596,068	593,114	734,020	628,240	(2)
New Zealand	2,620	8,122	(2)	(2)	(2)

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[1] Shipments.
[2] Data not available.
[3] Shipments from Wabana mines.
[4] Approximate production.
[5] Production of Tofo mine.
[6] Exclusive of manganiferous iron ore carrying 12 to 30 per cent of manganese.
[7] Year ended Sept. 30.
[8] Russia in Asia included with Russia in Europe.
[9] Exports.
[10] Exclusive of bog ore, which is used mainly for the purification of gas.
[11] 175 kilograms.
[12] Exclusive of iron oxide used for paint.

BENEFICIATED IRON ORE

In 1929 the processes reported in use in the United States to improve the quality of the ore at the mines were crushing and screening, drying, hand picking, washing, jigging, electromagnetic separation, and sintering. Some operators combined two or more of these processes. Beneficiation of iron ore was reported at 64 mines in 10 States in 1929 and at 62 mines in 12 States in 1928. Some iron ore is also recovered in the form of dust from blast furnaces, but no statistics on it have been gathered. Ore so recovered, however, has been originally included in the statistics of shipments from the mines.

Beneficiated ore shipped from mines in the United States in 1929 amounted to 9,112,573 gross tons, valued at $27,215,529, increases of 6 per cent in quantity and 9 per cent in total value as compared with 1928. Such figures as are available for 1929 to show the relation between crude ore treated and beneficiated ore recovered indicate that in washing brown ore the ratios, by weight, of crude ore washed to resultant concentrates range from 6:1 to 3:1, in concentrating hematite from 3.029:1 to 1.07:1, in concentrating magnetite from 2.496:1 to 1.111:1, and in concentrating carbonate 1.306:1.

The quantity of crude ore beneficiated in the Lake Superior district in 1929 amounted to 10,995,420 gross tons, and the beneficiated ore recovered was 6,218,188 tons—a loss of 4,777,232 tons and a ratio of 1.768:1. In 1928 the crude Lake ore treated amounted to 8,969,662 tons and the beneficiated ore recovered therefrom was 5,435,929 tons—a loss of 3,533,733 tons and a ratio of 1.65:1.

Beneficiated iron ore shipped from mines in the United States, 1928 and 1929

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

State	Variety	1928		1929	
		Gross tons	Value	Gross tons	Value
Alabama	Brown ore	649, 645	$1, 546, 671	623, 557	$1, 553, 688
Georgia	do	73, 052	209, 877	58, 250	172, 345
Minnesota	Hematite	5, 485, 096	14, 703, 265	6, 210, 870	16, 135, 244
Missouri	do	69, 899	(1)	137, 181	(1)
New Jersey	Magnetite	348, 126	1, 345, 338	283, 953	1, 150, 948
New Mexico	do	184, 623	(1)	171, 585	(1)
New York	do	767, 743	2, 906, 055	875, 564	3, 941, 985
Pennsylvania	do	788, 044	3, 162, 303	644, 799	3, 114, 379
Tennessee	Hematite, brown ore	127, 323	283, 925	101, 796	234, 827
Virginia	do	27, 902	82, 914		
Washington	Magnetite			5, 018	(1)
Wisconsin	Hematite	19, 208	(1)		
Wyoming	do	80, 670	(1)		
Undistributed			833, 238		912, 113
		8, 621, 331	25, 073, 586	9, 112, 573	27, 215, 529

[1] Included under "Undistributed."

The next table gives the shipments of beneficiated iron ore beginning with 1914, the first year for which statistics were gathered, and the percentage of beneficiated ore to the total ore shipped. Except for a few years the increase in the tonnage of beneficiated ore shipped has been slow but steady. During the 5-year period 1914 to 1918 the shipments of beneficiated ore averaged 10.6 per cent of the total ore; during the next 5-year period (1919 to 1923) increased to 13.5 per cent; during the 5-year period 1924 to 1928 decreased to 13.2 per cent;

and in 1929 decreased further to 12.1 per cent. Minnesota has contributed more than 64 per cent of the total shipments of beneficiated ore during the period 1914 to 1929. During the 5-year period 1914 to 1918 an average of 10.2 per cent of the total shipments from Minnesota was beneficiated ore; during each of the 5-year periods 1919 to 1923 and 1924 to 1928 the proportion was 14.9 per cent; and in 1929 it was 13.4 per cent.

Iron ore shipped from mines in the United States, 1914–1929, in gross tons, and percentage of beneficiated ore to the total shipped

[Exclusive of ore containing 5 per cent or more of manganese and of ore sold for paint]

Year	Beneficiated	Total	Percentage of beneficiated to total	Year	Beneficiated	Total	Percentage of beneficiated to total
1914	4, 130, 298	39, 714, 280	10. 4	1922	6, 623, 144	50, 612, 620	13. 1
1915	5, 581, 029	55, 493, 100	10. 1	1923	10, 686, 992	69, 811, 472	15. 3
1916	8, 105, 011	77, 870, 553	10. 4	1924	7, 092, 539	52, 083, 375	13. 6
1917	8, 166, 564	75, 573, 207	10. 8	1925	8, 735, 672	63, 924, 763	13. 7
1918	7, 881, 570	72, 021, 202	10. 9	1926	8, 371, 829	69, 292, 832	12. 1
1919	7, 355, 934	56, 372, 784	13. 0	1927	8, 114, 673	61, 232, 473	13. 3
1920	8, 514, 838	69, 281, 341	12. 3	1928	8, 621, 331	63, 432, 826	13. 6
1921	3, 727, 621	26, 652, 528	14. 0	1929	9, 112, 573	75, 602, 734	12. 1

IRON AND STEEL

The records of the production and sales of iron and steel shown in the following pages are derived in part from data supplied by producers who report direct to the Bureau of Mines and in part from several other authoritative sources, such as the American Iron and Steel Institute, Metal Statistics, the Iron Age, and the Iron Trade Review. The statistics on imports and exports are from the Bureau of Foreign and Domestic Commerce.

PIG IRON

SHIPMENTS, VALUE, AND PRODUCTION, BY STATES

The shipments of pig iron, exclusive of ferro-alloys, reported by the manufacturers to the Bureau of Mines amounted to 41,549,161 gross tons, valued at $731,858,075, in 1929, an increase of 8 per cent in quantity and 11 per cent in total value as compared with 1928. The values given represent the approximate amounts received for the iron f. o. b. furnaces and do not include freight costs, selling commissions, and other items that are figured in some of the market prices of pig iron as published in trade journals.

The pig iron shipped includes metal produced from foreign as well as from domestic ore. Although the pig iron made from ore imported from Africa, Asia (Palestine), Australia, Brazil, Chile, Cuba, Newfoundland, Spain, and Sweden constitutes a very small percentage of the total production, it amounted in 1929 to 1,666,328 gross tons, valued at $30,245,009, as compared with 1,579,242 tons, valued at $29,508,576, from foreign ore in 1928. In the manufacture during 1929 of 1,643,098 gross tons of pig iron, 2,887,814 gross tons of foreign ore was reported to have been used, indicating an average pig-iron yield of 56.9 per cent from imported ore. Domestic ore and 6,817,314 gross tons of cinder, scale, and scrap, amounting in all to 79,148,240 tons, were reported used in making 40,118,390 tons of pig iron, indicating an average pig-iron yield of 50.69 per cent from domestic materials. The total production of pig iron, exclusive of ferro-alloys, reported to the Bureau of Mines, was 41,761,488 gross tons, compared with 37,410,897 tons in 1928, an increase of 12 per cent.

Pig iron shipped from blast furnaces in the United States, 1928 and 1929, by States

State	1928		1929	
	Gross tons	Value	Gross tons	Value
Alabama	2, 525, 812	$42, 194, 935	2, 697, 814	$43, 674, 910
Colorado	(1)	(1)	(1)	(1)
Illinois	4, 094, 514	73, 524, 773	4, 316, 096	79, 672, 295
Indiana	3, 842, 762	63, 622, 330	4, 279, 825	71, 416, 732
Kentucky	225, 545	(1)	194, 150	(1)
Maryland	971, 832	(1)	1, 111, 219	(1)
Massachusetts	(1)	(1)	(1)	(1)
Michigan	797, 776	15, 157, 535	841, 089	14, 099, 647
Minnesota	341, 203	(1)	376, 551	(1)
New Jersey	------------	------------	204	(1)
New York	2, 369, 814	39, 928, 960	2, 626, 771	46, 960, 186
Ohio	9, 266, 936	156, 883, 186	9, 446, 984	163, 480, 003
Pennsylvania	12, 289, 455	216, 425, 084	14, 058, 194	257, 154, 601
Tennessee	102, 718	1, 920, 901	104, 985	1, 938, 238
Utah	164, 071	(1)	(1)	(1)
Virginia	63, 175	1, 245, 809	44, 512	(1)
West Virginia	645, 038	(1)	653, 048	(1)
Wisconsin	(1)	(1)	------------	------------
Undistributed	[2] 603, 048	[2] 50, 447, 757	[2] 797, 719	[2] 53, 461, 463
	38, 303, 699	661, 351, 270	41, 549, 161	731, 858, 075

[1] Included under "Undistributed."
[2] Includes figures for States entered as "(1)" above.

Pig iron shipped from blast furnaces in the United States, 1928 and 1929, by grades

Grade	1928			1929		
	Gross tons	Value		Gross tons	Value	
		Total	Average		Total	Average
Charcoal	157, 129	$3, 600, 847	$22. 92	152, 482	$3, 487, 397	$22. 87
Foundry	4, 635, 241	80, 663, 751	17. 40	4, 441, 016	76, 447, 156	17. 21
Basic	22, 161, 988	370, 335, 434	16. 71	24, 448, 163	420, 843, 248	17. 21
Bessemer	8, 819, 220	160, 057, 038	18. 15	9, 836, 120	179, 191, 434	18. 22
Low-phosphorus	297, 473	6, 692, 910	22. 50	358, 258	8, 063, 880	22. 51
Malleable	2, 007, 868	35, 254, 883	17. 56	2, 130, 593	39, 815, 782	18. 69
Forge	89, 520	1, 633, 229	18. 24	100, 246	1, 820, 750	18. 16
All other (not ferro-alloys)	135, 260	3, 113, 178	23. 02	82, 283	2, 188, 428	26. 60
	38, 303, 699	661, 351, 270	17. 27	41, 549, 161	731, 858, 075	17. 61

Pig iron shipped from blast furnaces in the United States, 1910–1929

Year	Gross tons	Value	Year	Gross tons	Value
1910	26, 674, 123	$412, 162, 486	1920	35, 710, 227	$1, 140, 904, 096
1911	23, 257, 288	327, 334, 624	1921	16, 038, 619	389, 437, 792
1912	30, 180, 969	420, 563, 388	1922	27, 670, 738	608, 144, 858
1913	30, 388, 935	458, 342, 345	1923	38, 361, 379	946, 799, 378
1914	22, 263, 263	298, 777, 429	1924	31, 064, 129	665, 078, 972
1915	30, 384, 486	401, 409, 604	1925	36, 814, 702	739, 316, 333
1916	39, 126, 324	663, 478, 118	1926	38, 181, 053	749, 633, 468
1917	38, 612, 546	1, 053, 785, 975	1927	34, 866, 644	646, 226, 139
1918	38, 230, 440	1, 180, 759, 565	1928	38, 303, 699	661, 351, 270
1919	30, 130, 231	775, 915, 043	1929	41, 549, 161	731, 858, 075

The American Iron and Steel Institute reports that in 1929 the output of all kinds of pig iron and ferro-alloys increased 4,458,269 gross tons, or 12 per cent, as compared with 1928.

Pig iron (including ferro-alloys) manufactured in the United States, 1928 and 1929, in gross tons [1]

State	1928	1929	State	1928	1929
Pennsylvania	12,422,602	14,453,251	West Virginia	864,922	864,201
Ohio	9,098,739	9,795,648	Kentucky		
Illinois	3,942,412	4,357,971	Iowa	634,270	638,015
Alabama	2,546,009	2,709,881	Colorado		
Indiana	4,583,065	5,085,615	Utah		
Michigan			Maryland	1,050,876	1,166,204
New York	2,562,715	3,025,282	Virginia		
Massachusetts			Tennessee	110,837	138,753
Wisconsin	339,267	----------			
Minnesota		379,162		38,155,714	42,613,983

[1] American Iron and Steel Institute.

AVERAGE VALUES

Values at blast furnaces.—The average value of all kinds of pig iron given in the accompanying table is based on the reports of the manufacturers to the Bureau of Mines. The figures represent the approximate values f. o. b. at the blast furnaces and do not include the values of ferro-alloys. The general average value for all grades of pig iron at the furnaces, exclusive of ferro-alloys, was $17.61 a ton in 1929, an increase of 2 per cent over 1928.

Average value per gross ton of pig iron at blast furnaces in the United States, 1925–1929

State	1925	1926	1927	1928	1929
Alabama	$19.85	$20.21	$18.55	$16.71	$16.19
Illinois	20.81	20.26	19.17	17.96	18.46
Indiana	19.34	18.88	18.01	16.56	16.69
Michigan	22.19	20.65	20.00	19.00	16.76
New York	18.80	18.82	16.99	16.85	17.88
Ohio	19.58	19.23	18.34	16.93	17.30
Pennsylvania	20.59	20.03	19.04	17.61	18.29
Tennessee	21.16	22.51	21.73	18.70	18.46
Virginia	22.86	22.11	20.99	19.72	(1)
West Virginia	18.87	(1)	(1)	(1)	(1)
Wisconsin	21.34	21.37	(1)	(1)	----------
Other States [2]	19.83	18.59	17.73	17.10	16.83
Average for United States	20.08	19.63	18.53	17.27	17.61

(1) Included under "Other States."

[2] 1925: Colorado, Kentucky, Maryland, Minnesota, Missouri, New Jersey, and Utah; 1926: Colorado, Kentucky, Maryland, Massachusetts, Minnesota, New Jersey, Utah, and West Virginia; 1927–28: Colorado, Kentucky, Maryland, Massachusetts, Minnesota, Utah, West Virginia, and Wisconsin; 1929: Colorado, Kentucky, Maryland, Massachusetts, Minnesota, New Jersey, Utah, Virginia, and West Virginia.

Average value per gross ton of pig iron at blast furnaces in the United States, 1889–1929

1889	$15.78	1903	$19.12	1917	$27.29
1890	16.43	1904	14.13	1918	30.89
1891	15.50	1905	16.63	1919	25.75
1892	14.32	1906	19.98	1920	31.95
1893	11.90	1907	20.56	1921	24.28
1894	9.76	1908	15.96	1922	21.98
1895	11.14	1909	16.25	1923	24.68
1896	10.47	1910	15.45	1924	21.41
1897	9.85	1911	14.07	1925	20.08
1898	9.90	1912	13.93	1926	19.63
1899	18.00	1913	15.08	1927	18.53
1900	18.85	1914	13.42	1928	17.27
1901	15.25	1915	13.21	1929	17.61
1902	20.92	1916	16.96		

Commercial quotations.—The average monthly prices, according to published market quotations, of foundry, basic, and Bessemer pig iron at Valley furnaces and of foundry pig iron at Birmingham furnaces are summarized in the following table:

Average monthly prices per ton of chief grades of pig iron, 1928 and 1929 [1]

Month	Foundry pig iron at Valley furnaces		Foundry pig iron at Birmingham furnaces		Bessemer pig iron at Valley furnaces		Basic pig iron at Valley furnaces	
	1928	1929	1928	1929	1928	1929	1928	1929
January	$17.25	$17.50	$16.00	$16.50	$17.50	$18.00	$17.00	$17.50
February	17.25	17.50	16.00	16.50	17.50	18.00	17.00	17.50
March	17.25	17.69	16.00	16.08	17.50	18.19	17.00	17.62
April	17.25	18.00	16.00	15.50	17.50	18.50	17.00	18.00
May	17.24	18.31	15.69	15.00	17.37	18.81	16.38	18.31
June	16.79	18.50	15.88	15.00	17.00	19.00	15.56	18.50
July	16.69	18.50	15.50	14.62	17.00	19.00	15.75	18.50
August	16.50	18.50	15.64	14.50	17.00	19.00	15.75	18.50
September	16.50	18.50	16.25	14.50	17.00	19.00	15.75	18.50
October	16.74	18.50	16.25	14.50	17.24	19.00	16.66	18.50
November	17.32	18.50	16.37	14.50	17.82	19.00	17.32	18.50
December	17.50	18.50	16.50	14.50	18.00	19.00	17.50	18.50
Average	17.02	18.21	16.01	15.14	17.37	18.71	16.56	18.20

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[1] Metal Statistics, 1930.

PRODUCTION BY GRADES AND BY FUEL USED, TOTAL PRODUCTION, AND BLAST FURNACES

The statistics of production of pig iron by grades and by fuel used for 1925 to 1929, the total output of pig iron, and the number of furnaces in blast in 1928 and 1929 have been published by the American Iron and Steel Institute, as shown in the tables that follow. These figures include ferro-alloys. Metals produced by the use of electricity and by the use of coke and electricity together are included in coke pig iron.

Pig iron (including ferro-alloys) manufactured in the United States, 1925–1929, by grades, in gross tons

Grade	1925	1926	1927	1928	1929
Bessemer and low-phosphorus	9,419,461	10,042,324	9,105,915	9,013,847	9,877,240
Basic	19,667,380	21,168,407	19,357,064	22,124,410	24,911,654
Forge	240,652	216,277	144,532	88,362	167,930
Foundry	5,183,745	5,506,968	5,504,419	4,209,790	4,446,011
Malleable	1,553,636	1,681,897	1,699,583	1,922,970	2,312,813
Ferrosilicon	226,472	245,605	278,277	303,595	341,222
Spiegeleisen	65,755	76,215	100,720	419,213	476,655
Ferromanganese	260,029	318,891	293,626		
White, mottled, direct castings, and other ferro-alloys	83,436	116,145	81,509	73,527	80,458
	36,700,566	39,372,729	36,565,645	38,155,714	42,613,983

Pig iron (including ferro-alloys) manufactured in the United States, 1925–1929, by fuel used, in gross tons

Fuel used	1925	1926	1927	1928	1929
Bituminous, chiefly coke	36,504,402	39,208,849	36,398,791	38,012,754	42,475,790
Charcoal	196,164	163,880	166,854	142,960	138,198
	36,700,566	39,372,729	36,565,645	38,155,714	42,613,983

The next table shows the production in the United States of pig iron, including ferro-alloys, so far as it has been recorded. Statistics by years prior to 1916 will be found in Mineral Resources for 1918 and earlier years.

Pig iron (including ferro-alloys) manufactured in the United States, 1810–1929, in gross tons

1810–1860	10, 542, 548	1921	16, 688, 126
1861–1870	11, 366, 963	1922	27, 219, 904
1871–1880	24, 055, 278	1923	40, 361, 146
1881–1890	56, 902, 041	1924	31, 405, 790
1891–1900	98, 124, 754	1925	36, 700, 566
1901–1910	211, 321, 934	1926	39, 372, 729
1911–1915	137, 591, 093	1927	36, 565, 645
1916	39, 434, 797	1928	38, 155, 714
1917	38, 621, 216	1929	42, 613, 983
1918	39, 054, 644		
1919	31, 015, 364		1, 044, 040, 222
1920	36, 925, 987		

The number of furnaces in blast on June 30 and December 31 and the total number of stacks recorded for 1928 and 1929, exclusive of electric reduction furnaces, were as follows:

Blast furnaces (including ferro-alloy blast furnaces) in the United States, 1928 and 1929

State	In blast June 30, 1928	Dec. 31, 1928			In blast June 30, 1929	Dec. 31, 1929		
		In	Out	Total		In	Out	Total
Alabama	17	19	13	32	17	15	12	27
Colorado	3	3	2	5	2	3	2	5
Illinois	15	17	8	25	19	16	9	25
Indiana	14	14	4	18	16	11	7	18
Kentucky	2	2	3	5	2	2		2
Maryland	5	5	1	6	6	4	2	6
Massachusetts	1	1		1	1	1		1
Michigan	8	8	2	10	8	7	3	10
Minnesota	2	2	1	3	3	2	1	3
Mississippi			1	1			1	1
Missouri			2	2			2	2
New Jersey			2	2			2	2
New York	13	13	10	23	16	11	12	23
Ohio	46	45	18	63	47	32	27	59
Pennsylvania	60	68	39	107	79	53	54	107
Tennessee	3	1	10	11	4	2	7	9
Texas			1	1			1	1
Utah	1	1		1	1	1		1
Virginia	2	1	10	11	1	2	8	10
West Virginia	3	3	1	4	3	3	1	4
Wisconsin			3	3			2	2
	195	203	131	334	225	165	153	318

FOREIGN TRADE IN PIG IRON

Imports of pig iron into the United States during 1929 were 147,763 gross tons, valued at $2,398,488, an increase of 5 per cent in quantity and 7 per cent in total value as compared with 1928. India was again the chief source of imported pig iron in 1929, supplying 47 per cent of the total; the United Kingdom and the Netherlands were other important sources, supplying 26 and 16 per cent, respectively, of the total.

Pig iron imported into the United States, 1925–1929, by countries, in gross tons

Country	1925	1926	1927	1928	1929
North America:					
Canada	6,455	4,767	725	1,015	7,382
Dominican Republic	3				
Mexico		70	97	423	387
Europe:					
Belgium	11,068	7,488	699	272	284
France	9,814	28,449	3,000	30	101
Germany	75,052	157,094	9,211	695	103
Netherlands	54,904	69,054	29,380	26,989	24,189
Norway		2		1,186	3,400
Sweden	2,169	3,455	1,700	2,720	3,534
United Kingdom	96,869	92,083	21,129	50,944	39,140
Asia:					
China	200				
India, British	184,325	83,311	66,627	56,420	69,243
Japan	(1)				
Kwantung	566				
	441,425	445,773	132,568	140,694	147,763
Value	$7,951,283	$7,708,982	$2,254,355	$2,232,094	$2,398,488

[1] Less than 1 ton.

Pig iron [1] imported into the United States, 1920–1929

Year	Gross tons	Value	Year	Gross tons	Value
1920 [1]	185,944	$12,801,834	1925	441,425	$7,951,283
1921 [1]	44,036	2,014,926	1926	445,773	7,708,982
1922	383,445	8,670,860	1927	132,568	2,254,355
1923	367,778	9,005,077	1928	140,694	2,232,094
1924	209,109	3,741,213	1929	147,763	2,398,488

[1] Figures for 1920 and 1921 include ferro-alloys. Separate data not available prior to 1922.

Exports of pig iron from the United States in 1929 were 46,357 gross tons, valued at $830,225, a decrease of 45 per cent in quantity and 39 per cent in total value as compared with 1928. Canada was the best customer in 1929, taking 51 per cent of the total; Japan was next best, taking 37 per cent of the total. The average value of the pig iron exported was $17.91 a ton in 1929, as compared with $16.14 a ton in 1928.

Pig iron exported from the United States, 1928 and 1929, by countries, in gross tons

Country	1928	1929	Country	1928	1929
North America:			Europe—Continued.		
Canada	39,342	23,431	Germany	513	531
Cuba	595	261	Italy	223	90
Mexico	54	143	United Kingdom	217	209
Panama	909	392	Other countries	66	5
Other countries	285	115	Asia:		
South America:			China	304	50
Chile	440	848	Japan	39,762	16,930
Colombia	75	69	Philippine Islands	463	880
Peru	106	711	Oceania: New Zealand	6	14
Other countries	245	190		84,682	46,357
Europe:					
Belgium	1,000	590	Value	$1,366,794	$830,225
France	77	898			

Pig iron [1] exported from the United States, 1920–1929

Year	Gross tons	Value	Year	Gross tons	Value
1920 [1]	216, 828	$10, 074, 377	1925	32, 674	$724, 565
1921 [1]	28, 307	933, 093	1926	25, 208	523, 883
1922	30, 920	756, 842	1927	50, 992	1, 028, 425
1923	32, 318	862, 443	1928	84, 682	1, 366, 794
1924	41, 483	957, 921	1929	46, 357	830, 225

[1] Figures for 1920 and 1921 include ferro-alloys. Separate data not available prior to 1922.

WORLD PRODUCTION OF PIG IRON, BY COUNTRIES

The accompanying table shows the predominance of the United States in the manufacture of pig iron and, with the table giving exports from the United States, indicates that the consumption in the principal European countries is still comparatively small.

Pig iron (including ferro-alloys) produced, 1925–1929, by countries, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1925	1926	1927	1928	1929
Australia	446, 472	445, 739	525, 525	417, 468	337, 975
Austria	379, 921	331, 635	432, 749	458, 451	458, 973
Belgium	2, 542, 507	3, 368, 347	3, 709, 090	3, 856, 990	4, 095, 940
Brazil [1]	70, 000	70, 000	70, 000	70, 000	70, 000
Canada	606, 048	827, 438	778, 220	1, 100, 342	1, 189, 037
China	369, 617	400, 000	411, 148	[2] 300, 000	[2] 300, 000
Chosen	101, 933	118, 102	129, 022	148, 652	155, 514
Czechoslovakia	1, 166, 422	1, 087, 984	1, 260, 363	1, 569, 264	1, 644, 515
Finland	11, 352	8, 871	11, 860	8, 470	6, 608
France	8, 505, 244	9, 430, 025	9, 297, 000	10, 097, 000	10, 446, 000
Germany (exclusive of the Saar)	10, 088, 751	9, 636, 054	13, 088, 798	11, 803, 565	13, 397, 000
Saar	1, 453, 056	1, 638, 051	1, 770, 718	1, 936, 184	2, 104, 940
Great Britain	6, 362, 200	2, 497, 654	7, 409, 951	6, 717, 400	7, 701, 200
Hungary	93, 130	189, 208	300, 237	285, 461	367, 951
India, British	906, 838	936, 932	1, 163, 523	1, 072, 052	1, 370, 000
Italy	536, 245	558, 509	529, 489	548, 828	672, 280
Japan [3]	695, 916	821, 326	911, 261	1, 076, 862	1, 514, 800
Luxemburg	2, 363, 253	2, 559, 151	2, 732, 000	2, 770, 066	2, 906, 093
Mexico	49, 373	61, 796	40, 654	49, 442	[2] 50, 000
Netherlands	109, 315	142, 504	203, 692	258, 224	253, 776
New Zealand	1, 310	4, 061	3, 437	6, 464	4, 464
Norway	87, 931	97, 311	119, 836	134, 463	[2] 134, 000
Philippine Islands	398	306	200	197	[2] 200
Poland	314, 564	327, 471	618, 209	683, 951	704, 437
Rumania	64, 273	62, 979	63, 498	70, 123	[2] 70, 000
Russia [4]	1, 308, 733	2, 217, 933	2, 953, 514	3, 373, 500	4, 000, 000
Spain	530, 029	488, 696	593, 070	562, 821	752, 618
Sweden	458, 535	494, 663	454, 518	437, 512	489, 677
Union of South Africa	------------	20, 382	30, 610	9, 057	16, 510
United States	37, 289, 610	40, 004, 661	37, 152, 524	38, 768, 113	43, 297, 937
Yugoslavia	3, 494	18, 768	22, 651	29, 303	30, 885
	76, 916, 000	78, 867, 000	86, 787, 000	88, 320, 000	98, 543, 000

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[1] Official estimate of annual production.
[2] Approximate production.
[3] Includes pig iron produced at Government and other steelworks for conversion into steel.
[4] Year ended Sept. 30.

FERRO-ALLOYS

PRODUCTION, SHIPMENTS, VALUE, AND PRICES

In these reports the statistics on the output of ferro-alloys in the United States are separated from those of pig iron in order that the values given may be more nearly accurate. Although the quantity of ferro-alloys is relatively small, the values per ton are so high that failure to separate the figures would unduly increase the apparent average value of the pig iron.

The shipments of ferro-alloys of all classes in 1929 were 829,324 gross tons, valued at $75,506,078, an increase of 4 per cent in quantity and 13 per cent in total value as compared with 1928. The production of ferro-alloys was 869,563 gross tons in 1929, compared with 757,131 tons in 1928, an increase of 15 per cent. Ferro-alloys were made in 1929 at 12 blast furnaces, 14 electric furnaces, and 2 aluminothermic plants; in addition, 2 plants made ferrosilicon and 2 plants made ferrophosphorus as a by-product.

Ferro-alloys shipped from furnaces in the United States, 1928 and 1929, by varieties

Variety of alloy	1928		1929	
	Gross tons	Value	Gross tons	Value
Ferromanganese	310, 122	$29, 199, 990	334, 162	$33, 184, 012
Spiegeleisen	116, 911	2, 802, 108	123, 146	3, 336, 703
Ferrosilicon (7 per cent or more silicon)	310, 770	15, 199, 746	310, 280	15, 730, 950
Ferrotungsten	1, 975	3, 195, 690	3, 049	5, 828, 760
Ferrovanadium	1, 895	5, 085, 759	1, 767	4, 665, 720
Other varieties [1]	53, 022	11, 094, 746	56, 920	12, 759, 933
	794, 695	66, 578, 039	829, 324	75, 506, 078

[1] Ferrochromium, ferromolybdenum and calcium-molybdenum compounds, ferrophosphorus, ferrotitanium, ferrozirconium, silicomanganese and silicospiegeleisen, and zirconium-ferrosilicon.

Ferro-alloys shipped from furnaces in the United States, 1920–1929, in gross tons

Year	Ferromanganese	Spiegeleisen	Other varieties	Total	
				Quantity	Value
1920	276, 594	103, 672	232, 542	612, 808	$77, 519, 367
1921	111, 374	69, 230	68, 023	248, 627	21, 697, 785
1922	161, 612	70, 253	191, 415	423, 280	28, 259, 004
1923	226, 365	134, 086	219, 366	579, 817	49, 877, 231
1924	232, 821	76, 179	188, 244	497, 244	43, 249, 948
1925	254, 005	95, 890	266, 327	616, 222	53, 048, 100
1926	330, 070	82, 982	276, 206	689, 258	61, 368, 407
1927	291, 056	80, 892	274, 801	646, 749	55, 163, 574
1928	310, 122	116, 911	367, 662	794, 695	66, 578, 039
1929	334, 162	123, 146	372, 016	829, 324	75, 506, 078

The following records of average contract prices of ferromanganese and of spiegeleisen, by months, for the last four years show a wide range. The ferromanganese prices are quoted for material "delivered at Pittsburgh"; those for spiegeleisen are prices at producers' furnaces.

Quoted prices per ton of ferromanganese and spiegeleisen, 1926–1929 [1]

Month	Ferromanganese (delivered at Pittsburgh)				Spiegeleisen (at producers' furnaces)			
	1926	1927	1928	1929	1926	1927	1928	1929
January	$119.79	$104.79	$104.79	$109.79	$34.00	$37.00	$32.00	$34.00
February	119.79	104.79	104.79	109.79	34.00	37.00	32.00	34.00
March	102.29	104.79	104.79	109.79	34.00	37.00	32.00	34.00
April	92.79	104.79	104.79	109.79	34.00	37.00	32.00	34.00
May	92.79	98.54	108.19	109.79	34.00	35.50	32.00	34.00
June	92.79	94.79	109.79	109.79	34.00	34.80	32.00	34.00
July	92.79	94.79	109.79	109.79	34.00	34.00	33.00	34.00
August	92.79	94.79	109.79	109.79	34.00	33.35	33.00	33.20
September	92.79	94.79	109.79	109.79	34.00	33.00	33.00	33.50
October	99.79	94.79	109.79	109.79	34.00	30.15	33.00	34.00
November	104.79	94.79	109.79	109.79	38.75	30.00	33.00	34.00
December	104.79	103.42	109.79	104.79	37.00	31.00	34.00	34.00

[1] Iron Trade Review.

Ferromanganese.—The shipments of ferromanganese in 1929 amounted to 334,162 gross tons, an increase of 8 per cent over 1928. The average value per ton f. o. b. furnaces reported for ferromanganese was $99.31 in 1929, compared with $94.16 in 1928. Ferromanganese was made at 8 furnaces by 6 producers in 1929 and at 7 furnaces by 3 producers in 1928.

The production of ferromanganese in 1929 was 339,205 gross tons, containing about 269,000 tons of manganese (metal), an average of 79.3 per cent of manganese. In the production of ferromanganese in 1929 there were used 614,763 gross tons of foreign manganese ore, 46,385 tons of foreign ferruginous manganese ore, 27,558 tons of domestic manganese ore, 1,350 tons of iron ore, and 7,811 tons of cinder, scale, and scrap. The quantity of manganese ore used per ton of ferromanganese made was 1.894 tons in 1929, 1.891 tons in 1928, and 2 tons in 1927. Of the foreign manganese ore used in 1929 Russia supplied 267,600 gross tons; Brazil, 228,737 tons; India, 86,547 tons; Africa, 28,592 tons; Cuba, 2,050 tons; Chile, 1,187 tons; and Turkey, 50 tons. The quantity of domestic manganese ore used in the manufacture of ferromanganese in 1929 represented 4.3 per cent of the total manganese ore used, as compared with 6.3 per cent in 1928.

Manganese ore and other metallic materials consumed and ferromanganese produced in the United States, 1921–1929

Year	Materials consumed (gross tons)				Ferromanganese produced			Manganese ore used per ton of ferromanganese made (gross tons)
	Manganese ore		Iron and manganiferous iron ores	Cinder, scale, and scrap	Gross tons	Manganese contained		
	Foreign	Domestic				Per cent	Gross tons	
1921	208,376	17,839	143	2,092	104,129	76.17	79,319	2.172
1922	335,165	1,804	----------	5,252	150,010	78.55	117,836	2.246
1923	538,280	26,790	498	6,945	251,938	78.13	196,844	2.243
1924	443,260	20,133	909	4,434	211,965	78.21	165,776	2.186
1925	519,139	34,942	4,949	11,072	259,780	78,93	205,046	2.133
1926	619,898	36,309	8,064	5,122	318,052	79.25	252,066	2.063
1927	564,725	25,298	12,735	8,570	294,991	78.95	232,900	2.000
1928	566,859	37,827	23,159	8,395	319,770	78.62	251,400	1.891
1929	614,763	27,558	47,735	7,811	339,205	79.30	269,000	1.894

Manganese ore used in the manufacture of ferromanganese in the United States, 1928 and 1929, by sources of ore, in gross tons

Source of ore	1928	1929
Africa	25,039	28,592
Brazil	218,181	228,737
Chile	5,118	1,187
Cuba	14,280	2,050
India	96,232	86,547
Russia	208,009	267,600
Turkey	-----------	50
	566,859	614,763
United States	37,827	27,558
	604,686	642,321

Spiegeleisen.—The shipments of spiegeleisen in 1929 amounted to 123,146 gross tons, or 5 per cent more than in 1928. The average value per ton at the furnaces in 1929 was $27.10; in 1928 it was $23.97. Spiegeleisen was made at 5 furnaces by 4 producers in 1929 and at 4 furnaces by 3 producers in 1928.

The production of spiegeleisen in 1929 was 137,143 gross tons, containing 27,344 tons of manganese (metal), an average of 19.94 per cent.

Ferrosilicon.—The production of ferrosilicon in 1929 amounted to 325,034 gross tons, compared with 289,079 tons in 1928, an increase of 12 per cent. Of the ferrosilicon produced in 1929, 50.16 per cent was made by the blast-furnace process, 49.63 per cent by the electric-furnace process, and 0.21 per cent as a by-product of the manufacture of artificial abrasives in electric furnaces. The shipments of ferrosilicon in 1929 amounted to 310,280 gross tons, as compared with 310,770 tons in 1928.

Ferrotungsten.—The production of ferrotungsten in 1929 was 3,101 gross tons, containing 5,389,937 pounds of tungsten (metal), an average of 77.59 per cent of tungsten. Ferrotungsten was made at 3 furnaces by 3 producers in 1929 and at 4 furnaces by 4 producers in 1928. The greater part of the ferrotungsten produced in 1929 was made from foreign ores, chiefly from China and Burma. The domestic ores used came mostly from California, Colorado, and Nevada.

The shipments of ferrotungsten in 1929, amounting to 3,049 gross tons, contained 5,302,435 pounds of tungsten, and the average value per pound of contained tungsten was $1.10 f. o. b. furnaces, compared with 93 cents in 1928.

Ferrovanadium.—The production of ferrovanadium in 1929 amounted to 1,823 gross tons, containing 1,540,912 pounds of vanadium (metal), an average of 37.74 per cent of vanadium. Ferrovanadium was made at 4 furnaces by 3 producers in 1929 and at 5 furnaces by 5 producers in 1928. The ferrovanadium produced in 1929 was made chiefly from patronite and its oxidation products from Peru, although vanadium pentoxide made from roscoelite mined in Colorado entered in appreciable amount into the output of ferrovanadium.

The shipments of ferrovanadium in 1929 were 1,767 gross tons, containing 1,494,291 pounds of vanadium, and were valued at the furnaces at an average of $3.12 per pound of contained vanadium, as compared with $3.20 in 1928.

IMPORTS AND EXPORTS

The imports of the alloys of the rarer metals are not all reported separately but are grouped as shown in the next table. Ferromanganese constituted the bulk of the imports in 1929; 44 per cent of it came from Canada, 30 per cent from Norway, and 22 per cent from the United Kingdom.

Prior to the tariff of September 22, 1922, the Bureau of Foreign and Domestic Commerce recorded only the gross weight of the ferro-alloys imported. Since that date the import statistics are not uniform, the gross weight of some ferro-alloys and the contained rarer metal of others being recorded. The reader should bear in mind this change when comparing the quantities in the two following tables with quantities published before the change in tariff. The values, however, are comparable.

The exports of ferro-alloys are relatively unimportant. Ferromanganese and spiegeleisen, the exports of which in 1929 were only one-sixth those in 1928, constituted the greater part of the total exports in 1929.

Ferro-alloys and ferro-alloy metals imported for consumption in the United States, 1928 and 1929, by varieties

Variety of alloy	1928		1929	
	Gross tons	Value	Gross tons	Value
Ferromanganese (manganese content)	48, 844	$4, 899, 374	56, 969	$6, 126, 056
Spiegeleisen	5, 260	147, 406	13, 828	403, 853
Ferrochrome and chromium:				
Ferrochrome—				
Containing 3 per cent or more carbon (chromium content)	69	15, 344	37	8, 835
Containing less than 3 per cent carbon	611	170, 069	638	206, 311
Chrome or chromium metal	10	2, 508	21	5, 242
Ferrosilicon (silicon content)	4, 697	649, 739	9, 285	1, 388, 423
Molybdenum and ferromolybdenum (molybdenum content)	(1)	1, 385	1	2, 384
Titanium and ferrotitanium	17	6, 067	7	2, 517
Tungsten and ferrotungsten (tungsten content)	50	50, 849	211	376, 230
Ferrovanadium	107	215, 708	46	89, 229
	----------	6, 158, 449	----------	8, 609, 080

[1] 576 pounds.

Ferromanganese and ferrosilicon imported into the United States, 1928 and 1929, by countries

[General imports]

Country	Ferromanganese (manganese content)				Ferrosilicon (silicon content)			
	1928		1929		1928		1929	
	Gross tons	Value	Gross tons	Value	Gross tons	Value	Gross tons	Value
Canada	19, 026	$2, 495, 743	27, 474	$3, 593, 981	3, 497	$506, 646	7, 772	$1, 193, 261
France	384	63, 777	516	73, 929	--------	----------	--------	----------
Germany	23	3, 477	100	6, 713	(1)	6	1	468
Italy	611	95, 492	2, 096	330, 480	--------	----------	--------	----------
Norway	11, 896	934, 793	18, 743	1, 702, 579	954	127, 836	1, 651	208, 016
Sweden	43	5, 073	71	8, 599	--------	----------	--------	----------
United Kingdom	15, 567	1, 207, 830	13, 785	1, 100, 965	6	1, 369	--------	----------
	47, 550	4, 806, 185	62, 785	6, 817, 246	4, 457	635, 857	9, 424	1, 401, 745

[1] Less than 1 ton.

Ferro-alloys and ferro-alloy metals exported from the United States, 1927–1929, by varieties

Variety of alloy	1927		1928		1929	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Ferromanganese [1] Spiegeleisen [1]	1, 641	$61, 793	9, 440	$232, 990	1, 574	$59, 036
Tungsten and ferrotungsten (including tungsten wire)	9	164, 917	7	123, 354	46	325, 133

[1] Not separately classified.

STEEL

PRODUCTION

The following tables showing the production of steel were compiled by the American Iron and Steel Institute. No data whatever are available on the value of the output of crude steel at the mills, but the weekly issues and annual statistical reviews of the Iron Age give market quotations of prices of steel billets and some of the leading forms of finished steel. The price of Bessemer steel billets at Pittsburgh in 1929 ranged from $33 to $36 a gross ton; in 1928 it ranged from $32 to $33 a ton. Tank plates at Pittsburgh ranged from 1.9 to 1.95 cents a pound in 1929 and from 1.81 to 1.9 cents a pound in 1928. Structural shapes at Pittsburgh also ranged from 1.9 to 1.95 cents a pound in 1929 and from 1.81 to 1.9 cents a pound in 1928.

Bessemer steel ingots and castings manufactured in the United States, 1925–1929, by States, in gross tons

State	1925	1926	1927	1928	1929
Ohio	2, 963, 590	3, 035, 809	2, 440, 235	2, 577, 728	2, 724, 864
Pennsylvania	2, 354, 231	2, 420, 719	2, 108, 483	2, 293, 085	2, 427, 490
Illinois	740, 212	874, 047	835, 254	978, 511	1, 075, 356
Other States	665, 929	603, 993	807, 755	770, 871	896, 365
	6, 723, 962	6, 934, 568	6, 191, 727	6, 620, 195	7, 124, 075

Open-hearth steel ingots and castings manufactured in the United States, 1925–1929, by States, in gross tons

State	1925	1926	1927	1928	1929
New England States	296, 091	288, 533	256, 716	285, 767	325, 232
New York and New Jersey	1, 724, 720	2, 086, 525	2, 003, 599	2, 323, 333	2, 541, 856
Pennsylvania	14, 021, 750	15, 622, 857	13, 708, 156	15, 261, 713	17, 504. 807
Ohio	8, 799, 951	8, 628, 247	8, 266, 708	10, 179, 096	10, 241, 579
Indiana	4, 978, 558	5, 278, 230	5, 118, 620	5, 971, 416	6, 235, 333
Illinois	2, 817, 027	2, 871, 688	2, 741, 472	3, 239, 669	3, 607, 810
Other States	5, 396, 391	5. 915, 899	5, 973, 064	6, 852, 962	7, 896, 271
	38, 034, 488	40, 691, 979	38, 068, 335	44, 113, 956	48, 352, 888

According to these tables there was an increase of 8 per cent in the production of Bessemer steel and of 10 per cent in open-hearth steel in 1929 as compared with 1928; the total production of steel increased 9 per cent. Of the total output in 1929, 85.7 per cent was represented by open-hearth, 12.6 per cent by Bessemer steel, and 1.7 per cent by all other classes of steel.

Of the total output of open-hearth steel, 47,232,419 gross tons was made by the basic process and 1,120,469 tons by the acid process, compared with 43,200,483 tons of basic steel and 913,473 tons of acid steel in 1928.

The production of steel by the electric process in 1929 showed an increase of 19 per cent as compared with 1928.

Steel electrically manufactured in the United States, 1909–1929, in gross tons

Year	Ingots	Castings	Total	Year	Ingots	Castings	Total
1909	13, 456	306	13, 762	1920	346, 956	155, 196	502, 152
1910	50, 821	1, 320	52, 141	1921	84, 404	85, 095	169, 499
1911	27, 227	1, 878	29, 105	1922	191, 057	154, 982	346, 039
1912	14, 147	4, 162	18, 309	1923	279, 914	235, 958	515, 872
1913	20, 973	9, 207	30, 180	1924	225, 977	206, 549	432, 526
1914	15, 458	8, 551	24, 009	1925	335, 978	279, 534	615, 512
1915	46, 348	23, 064	69, 412	1926	325, 278	326, 445	651, 723
1916	126, 048	42, 870	168, 918	1927	371, 278	294, 809	666, 087
1917	239, 632	64, 911	304, 543	1928	453, 692	348, 568	802, 260
1918	403, 068	108, 296	511, 364	1929	532, 392	419, 039	951, 431
1919	272, 942	111, 510	384, 452				

Figures for the total production of electric steel in 1929 include 510,030 tons of alloy-steel ingots and castings that were alloyed with nickel, vanadium, tungsten, chromium, molybdenum, and other metals (415,963 tons of ingots and 94,067 tons of castings), compared with 433,096 tons (353,662 tons of ingots and 79,434 tons of castings) so alloyed in 1928.

On December 31, 1929, the number of completed plants equipped for the manufacture of steel by the electric process was 233, as compared with 225 plants at the end of 1928.

Steel produced in the United States, 1810–1929, in gross tons

Year	Bessemer	Open-hearth	Crucible	Other steel	Total
1810–1870	58, 482	2, 232	146, 370		207, 084
1871	40, 179	1, 785	31, 250		73, 214
1872–1880	4, 293, 896	245, 035	349, 730	76, 009	4, 964, 670
1881–1890	21, 596, 699	2, 387, 925	703, 489	37, 044	24, 725, 157
1891–1900	49, 387, 341	15, 392, 764	762, 446	35, 820	65, 578, 371
1901–1910	94, 048, 698	92, 418, 814	1, 051, 379	154, 683	187, 673, 574
1911–1915	42, 329, 520	98. 833, 090	544, 047	185, 692	141, 892, 349
1916	11, 059, 039	31, 415, 427	129, 692	169, 522	42, 773, 680
1917	10, 479, 960	34, 148, 893	126, 716	305, 038	45, 060, 607
1918	9, 376, 236	34, 459. 391	115, 112	511, 693	44, 462, 432
1919	7, 271, 562	26, 948, 694	63, 572	387, 404	34, 671, 232
1920	8, 883, 087	32, 671. 895	72, 265	505, 687	42, 132, 934
1921	4, 015, 938	15, 589, 802	7, 613	170, 444	19, 783, 797
1922	5, 919, 298	29, 308, 983	28. 606	346, 039	35, 602, 926
1923	8, 484. 088	35, 899, 657	44, 079	515, 872	44, 943, 696
1924	5, 899, 590	31, 577, 350	22, 473	432, 526	37, 931, 939
1925	6, 723, 962	38, 034, 488	19, 562	615, 512	45, 393, 524
1926	6, 934, 568	40, 691, 979	15, 493	651, 723	48, 293, 763
1927	6, 191, 727	38, 068, 335	9, 036	666, 087	44, 935, 185
1928	6, 620, 195	44, 113, 956	7, 769	802, 260	51, 544, 180
1929	7, 124, 075	48, 352, 888	5, 079	951, 431	56, 433, 473

FOREIGN TRADE IN STEEL

The following tables show the imports and exports of certain iron and steel products.

Iron and steel imported into the United States, 1927–1929

Article	1927		1928		1929	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Bar iron	4, 226	$193, 358	2, 443	$158, 014	2, 930	$197, 762
Boiler and other plate of iron and steel	4, 034	125, 519	8, 025	251, 930	3, 243	115, 836
Iron and steel scrap	60, 207	729, 334	63, 314	1, 006, 044	90, 479	1, 466, 525
Rails for railways	15, 455	422, 832	14, 019	432, 452	6, 236	184, 921
Sheets of iron or steel, skelp, saw plates and steel, n. e. s	15, 725	773, 319	22, 775	1, 012, 477	25, 218	1, 222, 151
Steel ingots, bars, etc	13, 672	706, 295	21, 439	908, 538	25, 493	1, 109, 061
Tin and terne plates	1, 064	191, 512	922	152, 608	286	71, 824
Wire and articles made from wire	--------	4, 135, 076	--------	4, 314, 378	--------	4, 400, 592
Wire rods	18, 881	942, 936	19, 298	1, 122, 409	15, 653	1, 045, 334
All other manufactures of iron and steel (not specially provided for)	--------	3, 751, 194	--------	3, 826, 165	--------	3, 914, 562

Iron and steel exported from the United States, 1928 and 1929

Article	1928		1929	
	Gross tons	Value	Gross tons	Value
Semimanufactures:				
Steel ingots, blooms, billets, slabs, and sheet bars	30, 101	$1, 232, 901	42, 578	$1, 499, 644
Iron and steel bars and rods—				
Iron bars	6, 232	492, 477	5, 072	332, 237
Steel bars	158, 475	9, 114, 056	183, 895	10, 170, 297
Alloy-steel bars	14, 078	1, 486, 568	15, 744	1, 660, 422
Wire rods	38, 623	1, 733, 693	42, 250	2, 012, 021
Iron and steel plates, sheets, skelp, and strips—				
Boiler plates	9, 029	433, 476	14, 045	642, 571
Other plates, not fabricated	161, 705	7, 966, 195	179, 651	9, 374, 994
Skelp iron or steel	131, 754	5, 383, 919	130, 977	5, 507, 363
Iron or steel sheets, galvanized	152, 228	14, 663, 965	151, 513	14, 759, 021
Steel sheets, black	179, 286	13, 576, 541	173, 601	14, 307, 338
Iron sheets, black	16, 290	1, 634, 497	15, 856	1, 597, 042
Strip steel, cold rolled	19, 742	1, 581, 425	17, 477	1, 577, 426
Hoop, band, and scroll iron or steel	38, 339	2, 397, 549	53, 386	3, 558, 337
Tin plate, terneplate, and taggers tin	249, 642	26, 345, 576	258, 965	28, 566, 189
Manufactures—steel-mill products:				
Structural iron and steel—				
Structural shapes—				
Not fabricated	202, 804	8, 753, 890	288, 513	12, 683, 746
Fabricated	54, 333	4, 629, 479	57, 484	5, 170, 345
Ship and tank plates, punched or shaped	4, 119	319, 369	6, 232	486, 715
Metal lath	5, 359	830, 401	5, 455	815, 533
Other structural shapes	34, 389	3, 163, 569	48, 385	4, 008, 002
Railway track material—				
Rails for railways	190, 925	6, 925, 616	146, 060	5, 331, 737
Rail joints, splice bars, fishplates, and tie-plates	27, 872	1, 737, 987	20, 491	1, 520, 626
Switches, frogs, and crossings	6, 881	1, 087, 483	5, 665	1. 087, 644
Railroad spikes	4, 901	347, 530	4, 057	292, 852
Railroad bolts, nuts, washers, and nut locks	2, 333	309, 786	2, 387	321, 526
Tubular products—				
Boiler tubes	18, 749	2, 300, 509	19, 507	2, 493, 907
Casing and oil-line pipe	119, 784	11, 399, 020	113, 584	11, 861, 066
Welded black pipe	74, 730	6, 323, 985	103, 266	9, 275, 651
Welded galvanized pipe	35, 576	3, 302 976	41, 920	3, 991, 720
Malleable-iron screwed pipe fittings	10, 108	2, 857, 330	12, 534	3, 926, 819
Cast-iron screwed pipe fittings	7, 288	1, 347, 804	15, 038	2, 362, 122
Cast-iron pressure pipe and fittings	9, 944	913, 670	14, 888	1, 443, 742
Cast-iron soil pipe and fittings	16, 632	1, 088, 137	16, 993	1, 230, 403
Wire and manufactures—				
Barbed	69, 198	4, 376, 680	58, 978	3, 748. 336
All other	69, 023	8, 671, 697	71, 086	9, 769, 681

Iron and steel exported from the United States, 1928 and 1929—Continued

Article	1928		1929	
	Gross tons	Value	Gross tons	Value
Manufactures—steel-mill products—Continued.				
Nails and bolts (except railroad)—				
Cut nails	1,296	$113,217	898	$100,437
Horseshoe nails	1,145	279,466	866	213,848
Wire nails	14,546	955,722	12,985	864,447
All other nails, including tacks and staples	7,452	1,291,605	8,490	1,469,495
Bolts, nuts, rivets, and washers (except railroad)	13,280	2,538,754	16,236	3,145,377
Castings and forgings—				
Horseshoes	468	73,302	439	68,726
Iron and steel, including car wheels and axles	50,631	7,685,217	55,334	8,315,309
Advanced manufactures:				
House-heating boilers and radiators		711,793		1,124,401
Tools—				
Axes		1,129,294		1,084,609
Hammers and hatchets		341,102		378,691
Saws, wood and metal cutting		2,105,579		2,212,521
Shovels and spades		357,961		339,859
All other tools		13,540,001		13,642,123

ANTIMONY[1]

By PAUL M. TYLER[2]

STATISTICAL SUMMARY

Summary of statistics for antimony in the United States, 1926–1929

	1926	1927	1928	1929
Average price for year of antimony at New York......cents per pound..	15.91	12.34	10.30	8.94
Imports for consumption:				
Antimony in ore....short tons..	1,559	2,015	2,185	1,865
Liquated antimony sulphide....do....	2,040	1,077	1,208	1,803
Metal....do....	11,506	9,891	9,684	11,073
Exports of foreign antimony....do....	184	363	599	509
Stocks of antimony in bonded warehouse at end of year....do....	962	1,773	1,471	1,461
Production of antimony ore....do....	99	--------	86	--------
Antimony contained....do....	43	--------	42	--------
Production of antimonial lead (from domestic and foreign ores)..do....	22,524	24,347	33,058	25,669
Antimony contained....do....	2,693	2,736	3,432	3,052
Recovery of secondary antimony....do....	16,230	12,400	11,900	11,131

INTRODUCTION

The domestic consumption of new antimony, which dropped substantially in 1927 and 1928, rose in 1929 almost to the high point registered in 1926. The general industrial activity, including a record output of automobiles, increased the demand for new metal and at the same time took care of the steadily growing revolving fund of secondary metal. Heavier buying by the railroads also contributed to the larger demand. Moreover, the gradual decline in price probably tended both to stimulate buying and to encourage the use of antimony in place of competing materials. In the absence of information with regard to consumers' stocks the possibility of buying in anticipation of the proposed increase in the tariff may be considered a further sustaining factor.

American mines have not been an important source of antimony ore, but in most years they have yielded at least a carload or two. For 1929, however, no shipments of antimony ore were reported to the Bureau of Mines. All the antimony produced in the United States was derived as a by-product of lead smelters.

MARKETS AND PRICES

Except for the antimonial lead produced by lead smelters, virtually all the domestic supply of antimony is imported. Usually three-fourths, and formerly a much larger portion, of this supply is imported in the form of metal, and the remainder is imported largely in the form of liquated antimony sulphide, antimony ore, and oxide of antimony. Substantial quantities of the element, however, are contained in the imported antimonial lead, or "type metal," as it is called. Only small quantities of antimony salts are imported. Metallic antimony is still known in the trade as regulus, but this archaic term is gradually falling into disuse. Liquated sulphide is variously known as crude antimony or *crudum*, needle antimony, and antimony matte, and like the metal is imported chiefly from China. It is used principally in the manufacture of oxide. Antimony ore has likewise been used to some extent for making oxide, but it is also employed by primary lead smelters and secondary smelters for making antimonial lead. Only high-grade ore (preferably containing in excess of 60 per cent of antimony and free from deleterious impurities, especially lead and arsenic) can be used economically for the manufacture of oxide of antimony. Recently the imports of ore have come principally from Mexico and South America. Antimonial lead is an alloy containing 12 to 20 per cent antimony; it is imported mainly from American smelters in Mexico. Antimony oxide is imported chiefly from China. The manufacture of the oxide now seems established in the United States on a firm basis. The demand is improved, and manufacturers are now investigating additional outlets, notably the paint field.

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[1] Work on manuscript completed June, 1930.

[2] Unless otherwise stated, statistics in this report were prepared by H. M. Meyer, and data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines. E. P. Youngman, also of the Bureau of Mines, assisted in assembling data with respect to foreign countries.

The antimony market is notoriously subject to violent price fluctuations, but during the last two years, owing in part perhaps to the steadying effect of stocks of antimonial alloy, scrap, and secondary metal, price changes have taken place relatively slowly. In 1929 the price of the metal declined quite gradually. The quotation for ordinary Chinese brands, which started the year at 9⅝ to 9¾ cents, was shaded almost steadily month by month until July, when it reached 8⅜ cents. During the second half of the year there were only minor fluctuations, the price at the close of the year being 8¼ cents. Cookson's "C" grade, which started the year at 15⅝ cents, was quoted throughout the last two quarters of the year at 14 cents a pound. Chinese needle antimony remained steady throughout the year at 8 cents a pound for lump and 10 cents a pound for powdered (200 mesh). The price of white oxide, 99 per cent, however, dropped sharply during the summer, the total range being from 15½ cents in January to 10½ to 11 cents in December.

Bolivian ore, 60 per cent, was quoted at the end of the year at $1.30 per short-ton unit, in New York. In English trade journals 50 per cent ores were quoted uniformly at 5s. ($1.20) per long-ton unit and 60 per cent ores were quoted most of the year at 5s. 9d. to 6s. ($1.40 to $1.45) per long-ton unit. These prices were the same as those quoted in 1928.

Prices of antimony (Chinese brands) per 100 pounds at New York City, 1913 and 1920–1929 [1]

Year	High	Low	Average	Year	High	Low	Average
1913	$9.250	$6.250	$7.520	1925	$20.250	$11.250	$17.494
1920	11.375	5.750	8.485	1926	23.750	9.500	15.988
1921	5.500	4.500	4.957	1927	15.000	10.750	12.393
1922	7.000	4.250	5.471	1928	11.375	9.500	10.305
1923	9.250	6.350	7.897	1929	9.750	8.250	8.956
1924	14.125	8.375	10.836				

[1] Compiled from Engineering and Mining Journal.

PRODUCTION

No production of antimony ore in the United States was reported for 1929. The production of antimonial lead in 1929 from domestic ores containing antimony as an accessory constituent was 17,062 short tons, with an antimony content of 2,311 tons, and from foreign ores 8,607 tons, with an antimony content of 741 tons; the output from foreign ores represents a decrease of almost 50 per cent in both gross weight and antimony content as compared with 1928. The recovery of antimony from old alloys, scrap, and dross in 1929 was 11,131 short tons.

Antimony minerals are widely distributed through Alaska. A considerable number of veins of high-grade antimony ore have long been known to occur at various places on Cleveland Peninsula, in the Ketchikan district, southeast Alaska, and antimony concentrates containing gold are shipped from time to time from the Fairbanks district. In 1928 interest was shown in the antimony lodes on Stampede Creek in the Kantishna district of the Yukon region.[3]

In Idaho antimony occurs in the Yellow Pine district. During the war some ore was shipped from this area, but when prices dropped to peace-time levels mining had to be abandoned because of the excessive cost of transportation. In 1929 the Yellow Pine Co. (one of the F. W. Bradley interests) completed construction of a 12-mile road, installed a compressor and mine equipment, and built a large number of mine-camp buildings. The primary object of this new development is gold, but the gold ores contain about 1 per cent of antimony in the form of stibnite which may be recovered by selective flotation and shipped as antimony ore suitable for the production of oxide.

The world production of metallic antimony is in the neighborhood of 30,000 short tons, of which the United States consumes somewhat more than one-third. World consumption reached 50,000 tons a year during the war, but it dropped to about 20,000 tons for a time after the war.

Mine production of antimony ores in the United States, 1920–1929, in short tons

Year	Ore	Antimony content
1920–21	---	---
1922	20	4
1923	40	10
1924	113	33
1925	123	33
1926	99	43
1927	---	---
1928	86	42
1929	---	---

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[3] Smith, Philip S., Mineral Industry of Alaska in 1928 and Administrative Report: U. S. Geol. Survey Bull. 813–A, 1930, pp. 70, 71.

SMELTER PRODUCTION OF ANTIMONIAL LEAD

By-product antimonial lead produced in the United States from both foreign and domestic ores, 1920–1929

Year	Short tons	Antimony content		Year	Short tons	Antimony content	
		Short tons	Value [1]			Short tons	Value [1]
1920	12,535	2,033	$345,000	1925	19,667	2,624	$918,400
1921	10,064	1,589	158,000	1926	22,524	2,693	856,400
1922	8,075	1,441	156,000	1927	24,347	2,736	675,800
1923	14,190	2,170	338,500	1928	33,058	3,432	707,000
1924	20,787	2,763	596,800	1929	25,669	3,052	545,700

[1] Calculated at average yearly price for ordinary brands of antimony as given by American Metal Market.

RECOVERY OF SECONDARY ANTIMONY

During 1929 (according to J. P. Dunlop) the recovery of antimony from old alloys, scrap, and dross was 11,131 short tons. Of this total 11,079 tons was recovered in the form of alloys and 52 tons as metallic antimony; 1,883 tons was recovered from antimonial-lead scrap treated at regular smelters, and 9,248 tons was recovered as metal and in alloys at secondary smelters.

Secondary antimony and antimony content of secondary alloys recovered from old alloys, scrap, and dross in the United States, 1920–1929

Year	Short tons	Value [1]	Year	Short tons	Value [1]
1920	5,600	$938,560	1925	10,840	$3,794,000
1921	4,720	464,400	1926	16,230	5,164,400
1922	7,090	765,700	1927	12,400	3,060,300
1923	8,021	1,252,800	1928	11,900	2,451,400
1924	9,404	2,025,600	1929	11,131	1,990,200

[1] Values calculated at average yearly price for ordinary brands of antimony as published by the American Metal Market.

The antimony in storage-battery plates is reused over and over. New battery plates contain up to 6 or 7 per cent of antimony, but because of admixture of lead oxide and various impurities the metal produced by smelting directly yields an alloy containing only about 4 per cent antimony and 96 per cent lead. This alloy is not easily disposed of, and for this reason some firms have added antimony ore to the charge when smelting the plates, while others add new metal to bring the percentage of antimony up to the desired amount. Various furnaces are used for smelting the plates, including reverberatory, electric, and sundry special types of furnaces, in addition to blast furnaces. As the hard lead produced by direct smelting has a relatively limited field of use, it is not so readily disposed of as the unalloyed metals of which it is composed. For this reason it is often advantageous to separate the lead and the antimony. Many of the processes hitherto employed for this purpose are not well adapted to alloys containing as much as 4 per cent of antimony. C. R. Hayward, however, has devised an economical method for producing pure soft lead from battery plates and recovering the antimony content in one operation. Both metals are in such condition that they can be sold readily; hence the process, in addition to its metallurgical advantages, may result in a marked reduction in inventories and interest charges on material in process.

IMPORTS AND EXPORTS

Antimony imported for consumption in the United States, 1920–1929

Year	Antimony ore[1]			Liquated antimony sulphide[2]		Metallic antimony[3]		Antimony oxides and other compounds[4]	
	Short tons	Antimony content		Short tons	Value	Short tons	Value	Short tons	Value
		Short tons	Value						
1920	1,709	682	$70,285	1,375	$123,902	9,817	$1,216,376	298	$25,260
1921	213	98	11,682	353	17,577	10,130	784,146	154	15,558
1922	------	------	------	689	40,108	9,344	659,242	379	65,538
1923	(5)	1,047	44,721	835	64,493	6,763	641,804	2,277	288,206
1924	(5)	899	62,999	558	52,393	6,778	840,434	1,207	190,252
1925	1,359	773	47,084	760	115,990	9,857	2,362,915	1,792	349,990
1926	2,497	1,559	287,258	2,040	343,705	11,506	3,144,330	2,259	517,584
1927	3,566	2,015	282,098	1,077	134,949	9,891	2,111,411	1,803	484,873
1928	3,912	2,185	313,127	1,208	158,231	9,684	1,641,265	2,643	448,156
1929	3,161	1,865	231,086	1,803	174,104	11,073	1,622,182	2,222	359,247

[1] Classified in tariff classification as "Antimony ore and stibnite containing antimony."

[2] Classified in tariff classification as "Antimony matte containing not more than 10 per cent of lead," also as "Needle or liquated antimony."

[3] Classified in tariff classification as "Antimony regulus or metal."

[4] Classified in tariff classification as "Antimony, oxide, salts, and compounds of."

[5] Figures not available.

Antimony imported into the United States, 1928 and 1929[1]

[General imports]

Country	Antimony ore			Antimony metal[2]	
	Gross weight (short tons)	Antimony content		Short tons	Value
		Short tons	Value		
1928					
Argentina	544	354	$40,185	------	------
Belgium	------	------	------	992	$155,317
Bolivia[3]	254	147	16,365	------	------
Canada	------	------	------	(4)	31
Chile[3]	1,498	898	107,512	------	------
China[5]	------	------	------	8,096	1,252,727
Germany	------	------	------	395	71,747
Hong Kong[5]	------	------	------	56	9,324
Mexico	1,467	694	138,952	1,574	269,551
Netherlands	------	------	------	22	4,088
Peru	149	92	10,113	------	------
United Kingdom	------	------	------	214	57,242
	3,912	2,185	313,127	11,349	1,820,027
1929					
Argentina	1,060	697	70,291	------	------
Belgium	(4)	(4)	30	1,112	185,070
Bolivia[3]	166	101	10,716	------	------
Canada	(4)	(4)	9	------	------
Chile[3]	940	587	68,844	17	2,018
China[5]	------	------	------	10,524	1,360,401
France	------	------	------	28	3,565
Germany	------	------	------	76	12,073
Hong Kong[5]	1	1	27	204	18,116
Mexico	946	448	79,417	1,180	181,708
Peru	48	31	1,752	------	------
United Kingdom	------	------	------	289	68,379
	3,161	1,865	231,086	13,430	1,831,330

[1] Includes large quantities of antimony metal that went into bonded warehouse and that are not included in the table of imports for consumption.

[2] Includes small quantities of liquated antimony sulphide, known in the trade as "crude antimony," "antimony matte," or "needle antimony."

[3] Imports credited to Chile originated mainly in Bolivia.

[4] Less than 1 ton.

[5] Nearly all the imports of antimony ore and metal from Hong Kong are of Chinese origin. Some of the material credited to other countries is possibly also of Chinese origin, having been transshipped in a foreign port.

Type metal[1] imported for consumption in the United States, 1920–1929

Year	Type metal		Assumed antimony content		Year	Type metal		Assumed antimony content	
	Short tons	Value	Short tons	Percentage		Short tons	Value	Short tons	Percentage
1920	14,944	$1,349,495	2,063	13.8	1925[1]	3,005	$463,134	850	28.3
1921	19,485	1,191,553	4,132	21.2	1926[1]	4,311	912,331	784	18.2
1922	22,448	1,120,814	5,476	24.4	1927[1]	439	65,049	106	24.1
1923	[2] 3,677	431,610	(3)	(3)	1928[1]	1,995	193,177	452	22.6
1924	[2] 644	100,367	(3)	(3)	1929[1]	2,720	180,679	295	10.8

[1] Classification for 1925 to 1929 is "Type metal and antimonial lead"; separate figures not recorded.
[2] Lead content only. Figures for gross weight for 1923 and 1924 not available.
[3] Data not available.

Foreign antimony (matte, regulus, or metal) exported from the United States, 1920–1929[1]

Year	Short tons	Value	Year	Short tons	Value
1920	448	$51,607	1925	94	$17,376
1921	150	15,741	1926	184	41,554
1922	19	1,548	1927	363	72,280
1923	8	1,047	1928	599	90,975
1924	140	14,441	1929	509	71,415

[1] During 1922 there was also exported, mainly to Canada, 112 tons of regulus or metal of domestic manufacture, valued at $13,961. This is the first export of domestic antimony of which there is any record. However, antimony manufactured in the United States from foreign ores and exported would also be classed as domestic exports. Similar exports for 1923–1929 are not shown.

METALLURGICAL DEVELOPMENTS

According to a German patent,[4] pure antimony is obtained by electrolytic deposition from a solution of antimony trifluoride containing 100 to 600 grams of sulphuric acid per liter, together with a small amount of free hydrofluoric acid, the anodes being of crude antimony. The electrolyte is prepared from crude antimony or antimoniferous material by treatment with concentrated sulphuric and hydrofluoric acids successively, followed by dilution and clarification. A process has been patented for leaching antimony ores with a nonoxidizing inorganic acid containing, as reducing agent, a metallic protoxide salt.[5]

In order to obtain maximum hardness, antimonial lead alloys containing up to 4 per cent antimony are melted with up to 1 per cent of arsenic, cadmium, sulphur, tellurium, thallium, or bismuth and, after casting, annealed at 240° C., quenched, and finally aged at 20° to 100° C.[6]

Variations in the atomic weight of antimony were reported by Muzaffar for specimens of antimony derived from different sources; McAlpine,[7] working with specimens of metal prepared from ores obtained from the same sources from which Muzaffar obtained his material, finds no evidence of variations. This work upon antimony derived from Hungarian and Bolivian stibnites is in accord with the findings of Krishnaswami,[8] who used antimony from Indian and Burmese ores.

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[4] Antimony: German Patent 294143, July 18, 1927; Chem. Age, vol. 19, No. 484, Oct. 6, 1928, p. 31.
[5] Goldman, Henryk, Treating Antimonial Ores: U. S. Patent 1719657, July 2, 1929.
[6] Beatty, W. E., Manufacture of Alloys: British Patent 309629, Jan. 14, 1928.
[7] McAlpine, R. K., The Atomic Weight of Antimony from Different Sources: Jour. Am. Chem. Soc., vol. 51, June, 1929, pp. 1745–1750.
[8] Krishnaswami, K. R., The Atomic Weight of Antimony from Different Sources: Jour. Chem. Soc., 1927, pp. 2534–2539.

TARIFF

To encourage the establishment of a domestic antimony-smelting industry and at the same time to protect further development of oxide manufacture in the United States, efforts were made in 1929 to increase the duties on both metal and oxide imported into this country from abroad. In the Senate Finance Committee's draft of the new tariff bill (H. R. 2667) a sliding scale of duties was proposed on the metal. The maximum duty was to be 4 cents a pound when the New York price, as quoted for the week preceding the date of arrival, should be not over 7 cents a pound. When the New York quotation advanced beyond 7 cents, the rate was to be progressively diminished until, when the price exceeded 14 cents a pound, no duty was to be charged. This novel attempt to stabilize prices failed eventually of adoption and the antimony rates in the tariff act of 1930 are the same as those in the act of 1922.

WORLD SOURCES

World production of antimony, 1921–1929, in metric tons [1]

[Compiled by L. M. Jones, of the Bureau of Mines]

Country [2]	1921	1922	1923	1924	1925	1926	1927	1928	1929
North America:									
Mexico	[3] 45	[3] 464	[3] 490	[3] 775	935	1,783	2,098	2,297	(4)
United States	--------	4	8	24	24	31	--------	30	--------
South America:									
Argentina	--------	[3] 1	[5] 5	[5] 120	[5] 10	(6)	--------	--------	(4)
Bolivia [3]	282	185	312	621	1,384	3,503	3,214	2,834	2,845
Peru	--------	--------	--------	--------	14	79	89	112	(4)
Europe:									
Austria	--------	139	62	1	--------	87	857	914	560
Czechoslovakia	384	100	453	1,066	535	938	1,586	967	(4)
France	1,276	834	691	1,027	964	586	658	893	1,025
Germany (Bavaria)	2	4	(4)	(4)	(4)	--------	--------	--------	--------
Italy	76	146	271	372	312	360	285	230	293
Portugal	--------	--------	8	14	15	--------	--------	(4)	(4)
Spain	--------	--------	25	--------	--------	14	10	6	(4)
Yugoslavia	(4)	(4)	131	414	139	182	279	258	313
Asia:									
China [3]	14,658	13,858	14,256	12,059	19,496	20,926	17,986	19,324	(4)
India, British	1	--------	--------	--------	5	53	244	181	(4)
Japan	--------	--------	--------	10	--------	--------	--------	--------	(4)
Turkey (Asia Minor) [7]	400	400	400	400	400	400	400	400	400
Africa:									
Algeria [3]	103	579	500	905	1,461	334	442	21	114
Morocco, Spanish [3]	--------	--------	--------	--------	--------	70	94	225	180
Nigeria [3]	(8)	(8)	(8)	--------	--------	--------	--------	--------	(4)
Southern Rhodesia	--------	--------	--------	--------	15	24	--------	40	(4)
Oceania:									
Australia—									
New South Wales	50	--------	--------	--------	12	34	51	48	25
Queensland	--------	--------	--------	--------	--------	3	2	1	--------
Victoria	141	605	421	130	54	--------	--------	1	1
Western Australia [3]	--------	--------	--------	--------	--------	(9)	--------	--------	--------

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[1] Approximate recoverable metal content of ore produced, exclusive of antimonial lead ores.

[2] In addition to the countries listed, antimony ore is reported produced in Siam and Chosen, as follows: Siam, 9 tons of ore in 1924; Chosen, 21 tons of ore in 1926 and 15 tons in 1927. As no information is available on the antimony content of these ores, the figures have not been included in the table.

[3] Exports.

[4] Data not available.

[5] Shipments. A large part of the shipments reported is probably of Bolivian origin and therefore may duplicate in part the quantities shown for Bolivia.

[6] Less than 1 ton. Estimated recoverable content of shipments in 1926 was 55 kilograms.

[7] Approximate annual output. (Imp. Inst., London.)

[8] Less than 1 ton. Estimated recoverable metal content of ores exported was as follows: 1921, 74 kilograms; 1922, 190 kilograms; 1923, figures not given.

[9] Less than 1 ton. Estimated recoverable metal content of ores exported in 1926 was 464 kilograms.

AUSTRIA

Antimony ore is produced in only one mine in Austria, in the Province of Burgenland. The ore, which averages under 10 per cent of antimony, is smelted locally.

BOLIVIA

Antimony occurs in numerous deposits in Bolivia from the Argentine border all the way to Peru. Many small mines widely distributed over the high plateau region were worked during the World War, notably in the vicinity of Uncia (Potosí); in the neighborhood of Porco (Potosí), especially the mines at Agua Castilla; in southern Bolivia, especially in the Sud Chichas region; in the general vicinity of Oruro; and in the Challapata district. Except for the first three years after the outbreak of the World War, antimony mining in Bolivia has not been conducted on a large scale, and even during the boom period the output came almost wholly from a large number of small mines. The war boom collapsed even before the armistice in 1918. In 1924 a revival began as a result of higher prices for the metal, but production, after advancing to 7,409 metric tons of ore in 1926, dropped off again to 5,834 tons in 1928.

Preliminary figures for 1929 indicate a slight increase but tend to confirm the prevailing impression that working costs in Bolivia are so high that few mines can be worked when the price of antimony metal in New York falls under 10 or even 12 cents a pound. Antimony ore in Bolivia is the main product of the mines where it is produced. Although antimony minerals are found in many of the gold mines they are not recovered. Antimonial lead ores are also found in Bolivia but are not mined. Occasionally ore containing as much as 1.5 per cent of lead can be sold, but when it contains more than about 0.5 per cent of lead or 0.3 per cent of arsenic the penalties usually absorb all the profit. Freight rates constitute a substantial handicap. Ocean rates from Chilean or Peruvian ports rarely go much above $5 a ton, but railroad freight from the Bolivian mines to the seaboard often amounts to double this figure. Export taxes under the law of February 28, 1924, are on a sliding scale, based upon the price of ore in London. When the price is under 6s. a unit, the tax is 44 centavos (about 14 cents in United States currency) for each 100 kilograms of fine antimony. According to the export statistics the antimony content of Bolivian ore is usually about 60 per cent. In 1929 Belgium took 56 per cent of the exports, Great Britain 27.5 per cent, the United States 13 per cent, and France 3 per cent.

Antimony ore produced in Bolivia and exported, 1908–1928 [1]

Year	Metric tons	Value [2]	Year	Metric tons	Value [2]
1908	919	$40,934	1919	237	$51,476
1909	494	19,956	1920	1,100	262,653
1910	524	37,793	1921	640	79,902
1911	311	26,635	1922	420	57,811
1912	91	8,890	1923	709	109,990
1913	62	4,831	1924	1,409	159,751
1914	186	11,919	1925	3,146	336,725
1915	17,923	4,843,782	1926	7,409	834,391
1916	27,413	6,616,739	1927	6,718	666,187
1917	23,381	6,625,071	1928	5,834	486,943
1918	6,836	1,617,667			

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[1] Figures for 1908 to 1925 from report of Stewart E. McMillin, American consul, La Paz, Dec. 3, 1925 (Bur. Mines For. File, 6810–3), p. 2. Those for 1926 to 1928 from questionnaires prepared in the American consulate, La Paz.

[2] Value originally reported in bolivianos converted to United States dollars as follows: 1908 to 1925, inclusive, converted on the basis of standard exchange; that is, 1 boliviano=$0.3893; 1926 to 1928, inclusive, converted at the annual average rate of exchange as published by the Federal Reserve Board.

BRITISH INDIA

India has numerous deposits of antimony, principally in the Amherst district and the Shan States of Burma; stibnite occurs also in Mysore, Madras, Bihar, Orissa, British Baluchistan, Punjab, and the Northwestern Frontier Provinces. As these deposits are not easily accessible, production has not been important.[9]

The ore, which contains 60 per cent or more of antimony, is smelted locally or made into liquated sulphide.

The production of antimonial lead obtained as a by-product in the lead refinery at the Namtu smelter of the Burma Corporation (Ltd.) increased from 503 long tons, valued at Rs. 1,33,065 (£9,930), in 1927, to 1,241 tons, valued at Rs. 3,17,011 (£23,658), in 1928. This product (which contains approximately 77 per cent of lead, 21 per cent of antimony, and from 6 to 8 ounces of silver to the ton) is exported to the United States for further treatment.

A small quantity of antimony ore is produced at Thabyn in the Amherst district, Burma. The output in 1928 amounted to 370 long tons, valued at Rs. 10,300 (£769), compared with 500 tons, valued at Rs. 10,500 (£784), in 1927.[10]

CANADA

Antimony ore is found in many of the Canadian Provinces, frequently associated with gold ores. In the last year or two there has been a renewal of interest in several of these deposits, but no production was reported for 1929. A little antimony, however, is sometimes recovered from the silver-lead-bismuth bullion produced by smelters treating cobalt ores. Imports of antimony into Canada in 1929 amounted to 1,746,525 pounds, valued at $147,643, compared with 1,529,823 pounds, valued at $140,958, in 1928. The imports of antimony salts in 1929 amounted to 58,829 pounds, valued at $8,703, compared with 23,024 pounds, valued at $5,326, during 1928.

The Lake George deposits in New Brunswick, about 24 miles north of Fredericton, were mentioned in the chapter of this series in Mineral Resources for 1928. Development work was continued in 1929, although on a somewhat reduced scale, the average number of employees in 1929 being only 22. Altogether the property comprises 3,840 acres, and more than 1,200 feet of headings have been driven. Recent exploration has been confined to the lower levels. The ore is said to continue to a considerable depth. It is proposed to treat the ore at the mine, as it is not particularly high grade. Fifty per cent antimony concentrates can be obtained with about $1 per ton value in gold.[11]

CHINA

In 1929 China shipped 8,500 short tons of regulus, 1,611 tons of oxide, and 1,814 tons of crude antimony to the United States, compared with 8,470 tons, 1,562 tons, and 577 tons, respectively, in 1928. Of the United States imports of regulus and liquated antimony in 1929, 80 per cent came direct from China, and doubtless a considerable part of the imports credited to various European countries represents reshipments of Chinese antimony.

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[9] Furness, J. W., The Marketing of Antimony: Dept. of Commerce Trade Inf. Bull. 624, 1929, p. 18.

[10] Pascoe, Edwin, Records of the Geological Survey of India: Vol. 62, pt. 3, Calcutta, 1929, p. 296.

[11] Johnson, Frederick C., American vice consul, Fredericton, N. B., Canada: Special report dated May 6, 1930.

Antimony is widely distributed throughout China, but the principal deposits are in the provinces of Hunan, Yunnan, Kweichow, Kwangtung, Szechwan, and Kwangsi. By far the greater part of the output, however, comes from Hunan and chiefly from the Sikwanshan mines. In 1929 American interests were investigating deposits in Kwangsi and Kwangtung. The Panchi mine has had a varied history; the Hwa Chang Co., which operated it during the war and for a time thereafter, was forced to suspend operations in 1920 as a result of the low prices then prevailing. In 1924 a new company (Weiyikiutung) was formed, and new furnaces were installed. The following paragraphs (partly abstracted) describe this operation, probably the largest in China.[12]

> The Panchi deposits are in rugged country; the hills are 700 to 800 meters in height and are crowned with precipitous peaks and cliffs. The bedrock is sedimentary, of the Ordovician age. The deposits may be grouped as follows: (1) Hei Wan Tze ridge, (2) Wan Chia Shan ridge, with Su Shih Lung as an extension, and (3) Hsu Ku An ridge. The mining so far has been confined to the first two ridges.
>
> The ores are stibnite, valentinite, and cervantite. The ore deposits are said to take the form of well-defined veins and are practically confined to the folded part of the slaty or phyllitic shales and phyllites. The two main ore veins were estimated to contain about 172,000 tons of antimony, or about 1,070,000 tons of raw ore, of which 140,000 tons of ore had been extracted by the latter part of 1929.
>
> The ore is mined by open stoping, and drilling is done by hand. Sometimes imported or native explosives are used. A miner working an 8-hour shift can produce 80 to 100 catties[13]; the daily output is 30 to 40 tons, from which 3 tons of white oxide and 2.8 tons of regulus may be extracted, the annual production of each reaching approximately 1,000 tons. The total number of employees is 1,242.
>
> The equipment of the mine consists of a boiler room, a power house, a smelting plant, and a workshop. In the boiler plant are installed two 150-horsepower Heine water-tube boilers, of which only one is operated all the time, with bituminous coal as fuel. The power house has an air compressor and an electric generator. The smelting plant has 16 shaft furnaces for oxidizing and roasting and 4 reverberatory furnaces for ore reduction. The workshop is equipped with lathe, drilling machine, planer, grinder, drill press, and other mechanical appliances, which are driven by electricity.
>
> Five loading stations have been established at Ju Shan Tao, Wan San Chow, Chan Chi, Tao Hwa Kiang, and Yi Yang for the transportation of ores and mine supplies. Ju Shan Tao is a center of distribution for products from and supplies to the different parts of the mine. The materials are carried by coolies at a cost of about 20 cents a ton. From Ju Shan Tao to Wan San Chow a 24-pound rail track was built, on which wagons are pushed by men at a cost of $1 a ton. When the load reaches Wan San Chow, it is tipped from the track, shoveled into baskets, and carried down the river bank by coolies to junks bound for Chan Chi. The transportation cost from Wan San Chow to Chan Chi amounts to $1.70 a ton. Between Chan Chi and Changsha steamboats and junks towed by steam launches are available, and the portage for this part averages from $2.60 to $3.60 a ton. The total cost of transportation from the mine to Changsha ranges from $5.50 to $6.70 a ton.
>
> The company has its head office at Changsha, the capital of Hunan Province, where sales are carried on. At Chan Chi, the general office consists of only two departments; that is, mining and smelting. So far, stoping, drilling, and ore preparation have all been done by contract, whereas in the smelting plant and workshops the wage system has been in force.

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[12] Hankow Herald, Panchi Antimony Mine is China's Large Producer: Sept. 7, 1929.

[13] A catty in China is 1⅓ pounds.

CZECHOSLOVAKIA

In a small way, Czechoslovakia produces both antimony ore and metal from Slovakia and Ruthenia (Sub-Carpathian Russia). In 1927 these two Provinces yielded from three operating mines 14,318 metric tons of ore (average content, 13.84 per cent antimony), valued at 2,889,510 crowns [14] ($85,593). From one plant 1,024 tons of regulus (99.6 to 99.8 per cent) was produced, valued at 6,141,900 crowns ($181,935). In 1928 three mines (out of a total of four in operation) produced 11,607 tons of ore (average content, 10.41 per cent antimony), valued at 1,441,812 crowns ($42,714). One metallurgical plant produced 795 tons of regulus, valued at 4,822,941 crowns ($142,880). During 1928, the shipments of regulus were distributed as follows: Bohemia, 103 tons; Moravia and Silesia, 32 tons; Slovakia, 1 ton; Germany, 454 tons; Austria, 139 tons; Poland, 85 tons; Rumania, 3 tons; Hungary, 32 tons; and Yugoslavia, 4 tons. Stocks on hand amounted to 94 tons.[15] Figures for 1929 are not available. However, according to a consular report [16]—

> In consequence of the recent drop in antimony prices on the world markets, three of Czechoslovakia's antimony mines, located in eastern Slovakia, were obliged to suspend operations. These mines, which employed 184 workers, * * * have been operated by a joint stock company, the majority of the shares being controlled by a financial group in Vienna.

MEXICO

In Mexico 1929 was a year of uncertainty due to the agitation for an increase in the tariff on antimony imports into the United States and the expectation that, in consequence of this increase, the principal Mexican smelter would be moved from its present location in San Luis Potosí and rebuilt across the border in Texas. In Sonora an insurrection hindered operations somewhat in March and April, but the reduction in output, as represented by ore exports to the United States, was caused principally by the fact that Thompson and Moreno, who had controlled the deposits in the Altar district for 15 years, were negotiating an optional agreement that was said to have been predicated upon the anticipated change in the American tariff.

Despite these handicaps Mexico produced a total of 2,709 metric tons of antimony (including the metal content of ore exported) in 1929. This output, though substantially less than the 3,578 tons produced in 1928, is nevertheless much larger than the figures for any other recent years.

Antimony deposits of commercial interest occur in Mexico in San Luis Potosí, Queretaro, Sonora, Durango, and Oaxaca; deposits of possible importance have been reported in the States of Guerrero, Hidalgo, Chihuahua, Zacatecas, Mexico, Lower California, and Coahuila. Several score deposits in all have been opened up by prospecting, but in recent years the bulk of the output has come from San Luis Potosí, where the Republican Mining & Metal Co., affiliated with the Cookson (British) interests, has operated a group of mines in the Catorce district and a smelter, near by, at Wadley, more or less regularly since about 1900. Formerly the same company also produced ore on a moderately extensive scale in Queretaro, but the mines in that State are some 60 miles from the railroad and have been virtually idle since 1914, when operations were terminated by revolutionary causes. Ore from the State of Oaxaca is sent to the smelter of Yucanini, which produces crude antimony. Antimonial lead is produced at Monterey, and the output is expected soon to increase as a result of the decision of the American Smelting & Refining Co. to refine all the work lead from its Mexican smelters in Mexico instead of in the United States.

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[14] The average annual rate-of-exchange value of the crown in 1927 was 2.9622 cents; in 1928, 2.9265 cents; and in 1929, 2.9609 cents.

[15] From Rapports de l'office de Statistique de la République Tchécoslovaque, for the years 1927 and 1928

[16] Frost, Arthur C., American consul general, Prague: Cons. Rept., Nov. 25, 1929, p. 25.

The production of antimony in Mexico in 1928 by States and by forms of product is shown in the accompanying tables. Eventually about 80 per cent of this antimony reaches the United States.

Antimony produced in Mexico in 1928, by States

State	Kilograms	Value	Per cent of total quantity
San Luis Potosí	2,095,483	$1,037,967	58.57
Oaxaca	11,764	5,827	.33
Sonora	544,859	269,886	15.23
Undetermined	925,692	458,529	25.87
	3,577,798	1,772,209	100.00

Antimony produced in Mexico in 1928, by forms of product

Form of product	Kilograms	Per cent
Ingots of antimony	2,175,803	60.81
Antimonial lead	569,235	15.91
Crude antimony	11,764	.33
Ore (antimony content)	820,996	22.95
	3,577,798	100.00

According to a letter from H. P. Henderson, Mexican deposits as a class are in limestone, usually not far (within a few miles at least) from intrusive rocks. A zonal arrangement with respect to ores of other metals has been noted. Cinnabar is sometimes observed farther from the igneous center than the antimony minerals; ores of other metals are nearer. In the antimony deposits, stibnite is the primary mineral but it is often completely altered to oxide minerals. The individual ore bodies are typically pockety; there is, however, usually a connection leading from one to another, and the mineralization is persistent and widespread. The ore replaces certain favorable beds of limestone, forming "mantos." Particularly in certain localities ore is also found in fissures, but there is a distinct tendency for the fissures not to be ore-bearing more than a fairly short distance from the "mantos."

TURKEY (ANATOLIA)

European newspaper dispatches state that during the building of the Samsun-Sivas Railway very promising deposits of antimony ore were discovered in the neighborhood of Tokat. The antimony content is given as 50 per cent.

PLATINUM AND ALLIED METALS[1]

By Hubert W. Davis[2]

CRUDE PLATINUM

Mine returns for 1929 indicate a production of 528 troy ounces of crude platinum in Alaska, 246 ounces in California, and 23 ounces in Oregon—a total of 797 ounces for the United States. In 1928, Alaska produced 150 ounces, California 357 ounces, and Oregon 21 ounces—a total of 528 ounces.

Platinum refiners in the United States report purchases of domestic platinum in 1929, as follows: Alaska 294 ounces, California 208 ounces, and Oregon 14 ounces—a total of 516 ounces or 151 ounces more than refiners purchased in 1928. Refiners in the United States also report purchases of 51,618 ounces of foreign crude platinum in 1929—852 ounces from Australia, 7 ounces from Canada, 45,687 ounces from Colombia, 6 ounces from Russia, and 5,066 ounces from South Africa; the total is 6,344 ounces less than the purchases reported in 1928. According to the Bureau of Foreign and Domestic Commerce the imports of platinum from Colombia during 1929 were 45,756 ounces, and the total imports of unmanufactured platinum were 115,221 ounces, an increase of 6 per cent as compared with 1928.

REFINED PLATINUM METALS

NEW METALS

Reports of refiners of crude platinum, gold bullion, and copper indicate that 47,977 ounces of platinum metals were recovered in the United States from these sources in 1929, a decrease of 19 per cent as compared with recoveries in 1928. It is estimated that 10,886 ounces of the total in 1929 were derived from domestic sources.

New platinum metals recovered by refiners in the United States, 1920–1929, in troy ounces

Year	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1920	36, 015	4, 309	418	409	393	41, 544
1921	51, 791	2, 686	286	581	1, 026	56, 370
1922	54, 142	1, 943	210	1, 301	122	57, 718
1923	46, 780	1, 934	280	787	16	49, 797
1924	57, 827	6, 065	680	1, 261	174	66, 007
1925	41, 300	7, 358	283	648	54	49, 643
1926	76, 154	6, 437	234	2, 113	43	84, 981
1927	41, 121	3, 879	256	631	163	46, 050
1928	51, 427	5, 148	1, 658	458	348	59, 039
1929	41, 760	5, 295	302	364	256	47, 977

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[1] Work on manuscript completed July, 1930.

[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

New platinum metals recovered by refiners in the United States, 1928 and 1929, by sources, in troy ounces

	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1928						
Domestic:						
Crude platinum	209	1	54	43	14	321
Ore	1					1
Gold and copper refining	4,421	4,761	31		55	9,268
	4,631	4,762	85	43	69	9,590
Foreign:						
Crude platinum	46,784	386	1,573	415	78	49,236
Gold and copper refining	12				201	213
	46,796	386	1,573	415	279	49,449
Total recovery	51,427	5,148	1,658	458	348	59,039
1929						
Domestic:						
Crude platinum	369	2	17	53		441
Ore	2			1		3
Gold and copper refining	5,249	5,056	27		110	10,442
	5,620	5,058	44	54	110	10,886
Foreign: Crude platinum	36,140	237	258	310	146	37,091
Total recovery	41,760	5,295	302	364	256	47,977

SECONDARY METALS

Secondary platinum metals are those recovered from the treatment of scrap metal, sweeps, and other waste products of manufacture that contain platinum. Although the figures in the following table undoubtedly contain some duplication it is believed that they are worth publishing.

Secondary platinum metals recovered in the United States, 1920–1929, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1920	51,255	3,100	3,355		57,710
1921	39,131	4,887	1,776	229	46,023
1922	40,062	4,193	1,937	496	46,688
1923	39,152	6,246	2,021	453	47,872
1924	45,474	5,784	2,200	1,013	54,471
1925	35,578	4,680	1,827	1,189	43,274
1926	38,795	5,647	1,478	217	46,137
1927	46,127	4,244	1,810	891	53,072
1928	47,157	4,156	2,090	2,428	55,831
1929	33,638	5,120	2,057	1,944	42,759

IMPORTS AND EXPORTS

Platinum metals imported for consumption in the United States, 1920–1929

Year	Troy ounces	Value	Year	Troy ounces	Value
1920	100,546	$10,617,440	1925	125,802	$13,230,148
1921	78,378	5,418,464	1926	134,797	13,451,835
1922	110,025	8,983,547	1927	148,769	12,413,494
1923	106,637	10,466,705	1928	135,233	9,357,737
1924	111,359	11,030,349	1929	155,075	9,119,479

Platinum metals imported for consumption in the United States, 1928 and 1929, by metals

Metal	1928		1929	
	Troy ounces	Value	Troy ounces	Value
Platinum:				
Ores of platinum metals (platinum content)	686	$49, 094	564	$43, 152
Grains, nuggets, sponge, or scrap	78, 399	5, 298, 665	74, 063	4, 466, 149
Ingots, bars, sheets or plates, not less than ⅛ inch thick	29, 362	2, 348, 840	40, 594	2, 640, 097
	108, 447	7, 696, 599	115, 221	7, 149, 398
Manufactures of, except jewelry	39	3, 146	2	697
Iridium	4, 212	672, 384	4, 470	887, 893
Osmiridium	5, 785	418, 829	6, 863	391, 025
Osmium	310	20, 337	1, 124	70, 515
Palladium	13, 463	407, 826	24, 364	532, 285
Rhodium	1, 887	102, 120	2, 073	61, 849
Ruthenium	1, 090	36, 496	958	25, 817
	135, 233	9, 357, 737	155, 075	9, 119, 479

Platinum metals (unmanufactured) imported into the United States, 1928 and 1929, by countries, in troy ounces

[General imports]

Country	Platinum			Iridium	Osmium and osmiridium	Palladium	Rhodium and ruthenium	Total
	Ores of platinum metals (platinum content)	Grains, nuggets, sponge, or scrap	Ingots, bars, sheets or plates, not less than ⅛ inch thick					
1928								
Australia					290			290
Brazil				13				13
Canada		1, 475	9			1, 530	438	3, 452
China		4						4
Colombia	680	52, 120			14			52, 814
France				165	551	122	658	1, 496
Germany		3, 250	19, 996	1, 856	217	101	8	25, 428
Italy		45						45
Japan		300	1, 500					1, 800
Soviet Russia in Europe		2, 815	3, 168	205				6, 188
Union of South Africa	6							6
United Kingdom		18, 390	4, 689	1, 973	5, 023	11, 710	1, 873	43, 658
	686	78, 399	29, 362	4, 212	6, 095	13, 463	2, 977	135, 194
1929								
Canada		679	24	1		815		1, 519
Chile		58						58
China		9						9
Colombia		45, 756		258	5			46, 019
Costa Rica		328						328
France					52		50	102
Germany		4, 337	8, 475	2, 058	235	11	400	15, 516
Japan		200	4, 700					4, 900
Soviet Russia in Europe		4, 908	9, 072	513				14, 493
Union of South Africa	350							350
United Kingdom	214	17, 788	18, 323	1, 640	7, 685	23, 538	2, 581	71, 769
	564	74, 063	40, 594	4, 470	7, 977	24, 364	3, 031	155, 063

Platinum exported from the United States, 1920–1929

Year	Unmanufactured		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
1920	1,302	$177,115	(1)	$111,014
1921	3,272	244,473	741	85,216
1922 Crude, scrap, and old	143	13,149	486	35,967
1922 Ingots, sheets, wire, and alloys	1,313	127,047		
1923	1,151	128,599	592	65,073
1924	5,854	643,282	1,274	136,948
1925	16,234	1,787,122	3,537	249,975
1926	11,573	1,253,795	1,898	160,648
1927	19,923	1,577,560	1,549	128,875
1928	9,050	619,478	2,168	160,554
1929	2,567	193,122	1,455	112,252

[1] Quantity not recorded.

Platinum exported from the United States, 1928 and 1929, by countries

Country	Unmanufactured (ingots, sheets, wire, alloys, and scrap)		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
1928				
Argentina	100	$5,682	79	$6,108
Brazil	115	9,485	115	13,680
Canada	549	51,521	1,168	75,227
Chile			32	4,657
China			6	403
Colombia			12	135
Cuba			1	78
France	1,350	100,277		
Germany	3,467	207,212	208	19,575
Japan	2,847	198,560	99	7,397
Mexico			3	544
Newfoundland and Labrador	1	91		
Panama			9	220
Peru			4	190
Philippine Islands			12	41
Sweden			1	141
Switzerland	2	110		
Union of South Africa			2	344
United Kingdom	619	46,540	417	31,814
	9,050	619,478	2,168	160,554
1929				
Argentina	128	8,480	247	14,800
Australia	1	195		
Barbados			7	479
Brazil	264	21,852	157	14,926
Canada	421	36,280	569	39,882
Chile	4	144	1	46
China	6	241		
Dominican Republic			2	298
Germany	1	165	133	12,100
Haiti			2	61
Japan	186	4,750	11	1,200
Malaya (British)			1	37
Mexico	5	367	7	576
Peru			13	403
Philippine Islands			15	1,575
Surinam			1	117
United Kingdom	1,551	120,648	289	25,752
	2,567	193,122	1,455	112,252

SALES BY REFINERS

The following table shows the sales of platinum metals by refiners in the United States in 1928 and 1929. The figures include the sales of platinum metals recovered by refiners in the United States; in addition they include the sales of considerable quantities of imported platinum metals which are handled by refiners in the United States.

The sales of platinum metals in 1929, as reported by refiners in the United States, were 191,619 ounces, as compared with 187,287 ounces in 1928, an increase of 2.3 per cent. The jewelry industry, the chief user of platinum, purchased 9,249 ounces less platinum and 514 ounces less palladium in 1929 than in 1928, but 477 ounces more iridium. The electrical industry bought 18,856 ounces of palladium, about half of the total palladium reported sold by domestic refiners in 1929 and slightly more than twice the amount sold to this industry in 1928. The electrical industry's purchases of platinum were about the same in 1929 as in 1928, but there was a considerable decrease in its purchases of iridium. The chemical industry bought more platinum and palladium in 1929 than in 1928, but the same amount of iridium. The dental industry purchased 2,121 ounces more platinum and 621 ounces more iridium in 1929 than in 1928, but 114 ounces less palladium.

Platinum metals sold by refiners in the United States, 1928 and 1929, by consuming industries, in troy ounces

Industry	Platinum	Palladium	Iridium	Others	Total	Percentage of total
1928						
Chemical	18,529	1,252	113	135	20,029	11
Electrical	21,316	9,150	1,525	2	31,993	17
Dental	10,930	12,270	167	10	23,377	12
Jewelry	93,468	4,965	3,260	815	102,508	55
Miscellaneous	5,431	2,136	963	850	9,380	5
	149,674	29,773	6,028	1,812	187,287	100
1929						
Chemical	20,260	1,345	113	233	21,951	11
Electrical	20,746	18,856	1,014	89	40,705	21
Dental	13,051	12,156	788	236	26,231	14
Jewelry	84,039	4,451	3,737	851	93,078	49
Miscellaneous	7,234	1,048	347	1,025	9,654	5
	145,330	37,856	5,999	2,434	191,619	100

STOCKS

Stocks of the platinum metals in the hands of refiners on December 31, 1929, amounted to 82,184 ounces, an increase of 5 per cent as compared with stocks at the beginning of the year.

Stocks of platinum metals in the hands of refiners in the United States, December 31, 1920–1929, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1920	46,747	16,565	4,196	216	67,724
1921	38,514	21,042	4,991	3,113	67,660
1922	41,900	24,975	7,559	1,583	76,017
1923	36,554	26,266	5,208	2,697	70,725
1924	40,464	27,400	3,622	3,053	74,539
1925	44,024	26,740	3,720	4,609	79,093
1926	64,203	31,950	3,933	5,485	105,571
1927	68,757	24,313	4,617	4,369	102,056
1928	45,710	23,018	4,523	5,019	78,270
1929	51,853	20,154	4,716	5,461	82,184

MARKET AND PRICES

CRUDE PLATINUM

Sellers of domestic crude platinum reported they were paid for metal content based on assay. Buyers reported purchases at $46 to $63 an ounce for domestic and $44 to $133 an ounce for foreign crude platinum. Buyers of foreign and domestic crude platinum in the United States who reported purchases in 1929 are as follows:

American Platinum Works, 225 New Jersey Railroad Avenue, Newark, N. .
Baker & Co. (Inc.), 54 Austin Street, Newark, N. J.
J. Bishop & Co. Platinum Works, Malvern, Pa.
Sigmund Cohn, 44 Gold Street, New York, N. Y.
Thomas J. Dee & Co., 1010 Mallers Building, Chicago, Ill.
Kastenhuber & Lehrfeld, 24 John Street, New York, N. Y.
Pacific Platinum Works (Inc.), 814 South Spring Street, Los Angeles, Calif.
Wildberg Bros., 742 Market Street, San Francisco, Calif.

REFINED METALS

Quotations[3] based on official prices quoted by a leading interest on small miscellaneous orders for refined platinum were reduced from $74 to $70 an ounce on January 2, which price continued until May 10, when a further reduction to $68 an ounce was announced. This price continued until September 12, when it was reduced to $65 an ounce, to be further reduced on December 14 to $63 an ounce, the closing price for 1929. The average of these quotations was $67.69 an ounce. Refiners reported the high price of platinum at $110, the low at $56, and the average for the year at $67 an ounce.

Iridium, 98 to 99 per cent sponge and powder, was quoted at $270 to $275 an ounce the first of the year, was reduced to $260 to $265 an ounce the latter part of January, and was further reduced to $230 to $240 an ounce the last of May. This price continued until September 28, when a reduction to $220 to $230 an ounce was announced. On December 7 the price was further reduced to $210 to $220 an ounce, and a week later to $200 to $210 an ounce, the price at the close of the year. Refiners gave the following prices: High, $450; low, $180; and average for the year, $229 an ounce.

Quotations on palladium at the beginning of 1929 were $42 to $44 an ounce; but on January 26 was announced a reduction to $38 to $40 an ounce, which price continued until September 28, when $36 to $38 an ounce was quoted. This price continued until October 26, when a reduction to $35 to $37 an ounce became effective and continued until the end of the year. Refiners reported a high of $50, a low of $31, and an average price for the year of $39 an ounce.

Rhodium was quoted at $40 to $55 an ounce from the beginning of 1929 until April 6, when a price of $45 to $56 an ounce was announced; this price was maintained to the close of the year.

Osmium quotations opened in 1929 at $55 to $65 an ounce, but on April 6 a price of $58 to $65 an ounce became effective and continued to the close of the year.

Ruthenium was quoted at $45 to $55 an ounce from the beginning of 1929 until July 6, when a reduction to $42 to $50 an ounce became effective and continued to the close of the year.

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[3] Engineering and Mining Journal, vols. 127 and 128, 1929.

WORLD PRODUCTION

World production of crude platinum from placers, 1921–1929, in troy ounces

Country	1921	1922	1923	1924	1925	1926	1927	1928	1929
Australasia:									
New South Wales	249	80	586	646	573	397	226	354	128
New Zealand	--------	--------	--------	--------	--------	31	33	35	7
Papua (osmiridium)[1]	360	100	[2] 145	[2] 119	[2] 116	[2] 49	60	37	29
Tasmania (osmiridium)	1,751	1,174	673	365	3,366	3,173	633	1,627	1,360
Canada	[3] 15	[3] 15	[3] 10	5	6	50	11	49	28
Colombia	[4] 35,500	[4] 40,000	[4] 42,000	[4] 46,000	[4] 45,000	[5] 44,565	[5] 45,830	[5] 53,531	[5] 45,577
Ethiopia	--------	--------	--------	--------	--------	480	2,251	3,247	7,716
Japan	231	150	224	145	189	198	47	100	(6)
Madagascar	--------	--------	--------	--------	--------	--------	--------	2	--------
Mexico	--------	--------	--------	--------	--------	30	--------	--------	(6)
Philippine Islands	--------	1	14	--------	4	8	31	--------	(6)
Russia	[4] 20,000	[7] 27,200	[7] 38,000	[7] 66,841	[7] 94,780	[7] 92,691	[8] 100,000	[9] 78,925	[10] 99,667
United States	977	1,008	609	335	343	286	153	528	797

[1] For year ended June 30 of year stated.

[2] Exports.

[3] Estimated by J. M. Hill. The Dominion Bureau of Statistics Ann. Repts. give the placer output of Canada, in troy ounces, as follows: 1921, 23; 1922, 12; 1923, 7.

[4] Estimated.

[5] Based on data personally communicated to the author.

[6] Data not available.

[7] Figures as published by the Geological Committee, Russia, in Annual Rept. on the mineral resources of the U. S. S. R., vol. 1, Leningrad, 1927.

[8] Estimated production, Imp. Inst., London; includes recoveries from imported concentrates.

[9] Exports; year ended Sept. 30.

[10] Year ended Sept. 30.

The following table gives data by which the figures showing the production of crude platinum as given in the foregoing table can be reduced to terms of the refined metals used by the industries.

Average assay of crude platinum, in per cent

Country	Platinum	Palladium	Iridium	Osmium	Rhodium, ruthenium, etc.
Australasia:					
New South Wales	75.9	----------	1.3	----------	1.3
Papua	----------	----------	58.1	33.5	3.0
Tasmania	----------	----------	58.1	33.5	3.0
Canada	72.1	0.2	1.1	----------	2.8
Colombia	86.69	.54	[1] .85	----------	----------
Japan	.2	----------	49.8	37.3	3.9
Russia	83.5	1.9	1.9	3.0	.6
United States	85.5	.6	1.1	1.3	1.0

[1] Iridium and osmiridium.

NOTES ON PRODUCTION BY COUNTRIES

UNITED STATES

The mine production of Alaska in 1929, as reported by the United States Geological Survey, amounted to 528 ounces of crude platinum. Most of the production was from the Kuskokwim region, but some was produced in the Koyuk district of the Seward Peninsula. The mine production in 1928 was 150 ounces, of which 20 ounces came from placers in the Dime Creek district of the Seward Peninsula and 130 ounces from the Kuskokwim region.

In California mining companies reported the production of 246 ounces, as compared with 357 ounces in 1928.

The production of platinum in Oregon in 1929 was 23 ounces, as compared with 21 ounces in 1928.

AUSTRALASIA

Production of platinum metals in Australasia in 1929 was as follows: 128 ounces of platinum from New South Wales (354 ounces in 1928), 7 ounces of platinum from New Zealand (35 ounces in 1928), 29 ounces of osmiridium from Papua (37 ounces in 1928), and 1,360 ounces of osmiridium from Tasmania (1,627 ounces in 1928). The production of platinum metals in New South Wales[4] in 1928 was all from the Fifield division. At the end of 1928 about 60 men were engaged in prospecting. Continuous efforts were made during 1928 to find a new lead or a continuation of the old one, but so far without success. At Broken Hill, R. Finlay continued experimenting in 1928 in an effort to find a successful commercial process for treating complex platinoid ore.

The production of osmiridium in Tasmania in 1928 was all from the Adams River field. The Adams River workings are in the northeast part of the county of Arthur, about 56 miles west-northwest of Hobart. This field, after Russia, is the chief source of supply for the coarse-grained variety of osmiridium, although South Africa supplies from the Rand larger quantities of fine-grained material.[5] The history of the field since its discovery in 1925 has been very checkered, corresponding to the fluctuations in the price of this rare metal. In 1928 considerable recovery was experienced from the slump of 1927, the total output amounting to 1,627 ounces as compared with 633 ounces in 1927. Altogether the field is reported to have produced about 7,666 ounces since regular working began in 1925. The osmiridium won has been entirely from secondary deposits, and nothing of a primary character has yet been located. The average of a large number of samples shows iridium 41.65 per cent (the extreme variations being 44.35 per cent and 36.30 per cent); osmium 45.51 per cent (extremes 50.20 per cent and 43.31 per cent); ruthenium 6.40 per cent (extremes 10.60 per cent and 5.29 per cent); platinum 1.12 per cent; and rhodium 0.29 per cent.

CANADA

The production of crude platinum in Canada in 1929 was 28 ounces, as compared with 49 ounces in 1928.[6] Recoveries of platinum metals in 1929 from Sudbury nickel-copper ores were 12,811 ounces of platinum and 13,717 ounces of other platinum-group metals, as compared with 10,483 ounces of platinum and 13,607 ounces of other platinum-group metals recovered in 1928.

With the exception of a few ounces of platinum obtained from the black sands of British Columbia and a small production obtained as an impure residue in the refining of gold at Trail, British Columbia, all the Canadian platinum and allied metals are obtained from the treatment of the Sudbury nickel-copper matte.[7] The successful development of the Frood and Frood Extension copper-nickel mines near Sudbury will add considerably to the Canadian production of metals of the platinum group, as the ores of these mines are reported to contain high values in these metals. The Acton refinery at Acton, near London, England, owned by the International Nickel Co., is a new and efficient plant designed to treat precious metal residues. To provide refining capacity for the large output of platinum metals from the Frood mine, beginning in 1930, this refinery is now being substantially enlarged.

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[4] Department of Mines, New South Wales, Annual Report for the Year 1928: Sydney, 1929, p. 33.

[5] Mining Journal (London), Tasmanian Osmiridium: Vol. 156, No. 4908, 1929, p. 747.

[6] Dominion Bureau of Statistics, Ottawa, 1930. Preliminary Report on the Mineral Production of Canada during the Calendar Year 1929.

[7] Mines Branch, The Canadian Mineral Industry in 1929: Ottawa, 1930, p. 11.

Designs are being prepared for a unit to treat slime containing precious metals precipitated in the process of refining International Nickel blister copper at the new Ontario refining plant, being built at Copper Cliff, Ontario, by International Nickel, American Metal, and Consolidated Mining & Smelting.[8] Ores of the Sudbury district, particularly those from the Frood mine, contain substantial amounts of gold, silver, and platinum-group metals in addition to nickel and copper. In treating these ores the platinum-group metals tend to separate with the nickel, and the gold and silver are generally found with the copper. Gold and silver will consequently be the chief precious metals recovered in the new unit, although some platinum and palladium will also be refined. Other platinum-group metals, such as osmium and iridium, will be shipped to the International Nickel plant at Port Colborne for refining. The new unit will be built east of the electrolytic section of the refinery.

That the increase in capacity by the International Nickel Co. has caused some concern among producers of platinum is indicated by the following comment in the Canadian Mining Journal.[9]

> While the big increase in smelter capacity at International Nickel is regarded in Canada as a step toward production records which will be handed down through years to come as mining history, producers of platinum in other parts of the world are seriously alarmed over the big program owing to the attendant output of platinum as a by-product. Even now it is necessary to handle the marketing of platinum carefully so as to avoid unfavorable market disturbances. Therefore, much importance is attached to the fact that within the next two years International Nickel will increase its platinum output from 50 to 100 per cent. Russia has, up to the present time, been quite safely entrenched, yet the forthcoming increase in the Sudbury area is now regarded as a serious threat to the platinum mining industry of the country. However, the research department of International Nickel found new uses for nickel—permitting the large increase in production—and it is quite possible that uses for platinum which will offset the forthcoming increase will also be found.

COLOMBIA

The exports of crude platinum from Colombia in 1929 were 45,577 ounces, of which 24,677 ounces was the product of dredges and 20,900 ounces was the product of hand working by native operators. Refiners of platinum metals in the United States reported purchases of 45,687 ounces of Colombian crude platinum in 1929 and 53,744 ounces in 1928.

The South American Gold & Platinum Co. in 1929 produced approximately 23,400 ounces of crude platinum and 8,054 ounces of crude gold. In 1928 this company produced approximately 26,358 ounces of crude platinum and 8,555 ounces of crude gold. During 1928 three dredges were operated with only minor interruptions; in consequence, the yardage of gravel handled was the greatest so far attained and resulted in the largest production of metals since the inception of operations. The work of drilling the properties of the company for the purpose of blocking out reserves of payable gravel was carried on throughout 1928; in consequence, a large addition to the gravel reserves was developed. Toward the end of 1928 dredge *No. 2* was moved down the Condoto River to a new area of operation, but work was halted by extreme low water—an unexpected condition for this period of the year—and was not resumed until April, 1929. A bucket line of larger capacity was installed on dredge *No. 3* during 1928, a change that should materially increase the digging capacity with lower operating costs per cubic yard and thus make available a large amount of low-grade ground, which otherwise could not be dredged at a profit.

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[8] Engineering and Mining Journal, vol. 129, Jan. 23, 1930, p. 92.

[9] Canadian Mining Journal, International Nickel—Increased Output of Platinum Alarms Other Producers: Vol. 50, June 21, 1929, pp. 583–584.

ETHIOPIA (ABYSSINIA)

The production of crude platinum in Ethiopia in 1929 was 7,716 ounces, as compared with 3,247 ounces in 1928.

According to Robertson [10]—

> A French company, the Société Minière des Concessions Prasso en Abyssinie, with a capital of 9,000,000 francs, is working alluvial platinum deposits at Jubdo on the Birbir River near the head waters of the Blue Nile about 16 days trek on mule back west of Addis Ababa. I understand that some of these so-called alluvial deposits are in reality tailings from very ancient gold workings, gold having been obtained from Abyssinia in the time of the Queen of Sheba. The alluvial deposits are from 6 to 12 meters in depth, and average about ½ gramme of platinum to the cubic yard. In this depth there is a streak of ground about 2 inches thick, near the bottom, which carries up to 15 grammes of platinum per cubic yard. The bed of the river is also rich, but the alluvium in the river bed is not deep. At the present time these deposits are being worked in a very primitive manner by tributors and all the platinum is obtained by panning, no sluicing being carried on, and the native tributors only work the rich streak. The concentrates obtained contain from 70 to 75 per cent platinum or metals of the platinum group and 3 per cent gold. I understand that the Prasso company is obtaining from 6 to 10 kilogrammes of platinum per month. I was told also that a London syndicate, the Abyssinian Development Syndicate, had this property at one time and were working it for gold. Other companies and syndicates are also working platinum deposits and producing platinum. The manager of the Bank of Abyssinia told me that he was buying a very considerable amount of this metal. A German syndicate has sent an expedition to Bini Sangue near the Western boundary of Abyssinia to prospect for gold. This expedition came into Abyssinia from Khartoum.

Certain details of two platinum concessions in Ethiopia are given by Chesbrough.[11]

> In the Province of Beni Shangul, 100 areas, each 5 by 5 kilometers square, or a total of approximately 900 square miles, comprise the concession granted by King Tafari to the Deutsches Studiensyndikat of Stuttgart, Germany. It provides for the prospecting and exploitation of all mineral deposits in the allotted district, which includes gold and platinum. The terms have been accepted by King Tafari and ratified by the German minister at Addis Ababa. Already 12 areas have been registered and it is expected that work on these will be begun after the rainy season in October.
>
> Deposits in this district are mostly in river beds where placer mining and washing are carried on by the natives. The Province of Beni Shangul lies along the Sudan frontier opposite Kurmuk, to which point metals extracted could be most easily and economically shipped. From Kurmuk they may be transported abroad by truck and rail through the Sudan to Khartoum or Port Sudan. Precious metals of high value, such as platinum and gold, could be carried to Khartoum by airplanes. It is necessary for the concessionnaire to secure the approval and permission of the governor of the Province in order to operate in the areas granted.

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[10] Robertson, H. P., Traveling in Abyssinia: Mining Mag. (London), vol. 40, No. 6, June, 1929, pp. 338–339.

[11] Chesbrough, R. F., Trade Commissioner, Cairo, Egypt, Exploitations of Mineral Areas in Ethiopia: Commerce Repts., No. 40, Oct. 7, 1929, pp. 30–31.

In the Deutsches Studiensyndikat gold and platinum deposits have been found together in the river beds, usually at a depth of 3 to 6 feet. Alluvial gold has been assayed to run 32 grams per cubic meter. Samples of platinum from this district have been analyzed and found to contain 70 per cent platinum, 10 per cent gold, 7 per cent iridium, 3 per cent osmium, and 10 per cent palladium and other foreign matter.

An Italian citizen has obtained from the King concessions in Beni Shangul, and in the adjoining Province of Wollaga where rich alluvial deposits of gold and platinum exist. The territory has been allotted in the form of seven circles, each having a radius of 5 kilometers from a given point.

Seven of these areas already have been worked and in 1928 70 kilos of platinum were produced and sold in Europe at prices ranging from 55,000 to 100,000 French francs per kilo. During December, 1928, and January, 1929, 38 kilos were extracted. The work was done by hand, by natives who were paid the equivalent of $0.50 per gram for gold or platinum turned in. The production was taken across the border and shipped abroad through the Sudan. According to the terms of the concession, 10 per cent of the output is given to the Ethiopian Government. There has been a dispute between the Ethiopian Government and the holders of this concession concerning area, and settlement has been placed in the hands of an arbitration board in Addis Ababa.

RUSSIA

The Soviet platinum output for the fiscal year ended September 30, 1929, according to Jewelers' Circular,[12] is reported to have reached a total of 3,100 kilograms (99,667 ounces), with a further material increase in the production of the Ural platinum mines and refineries marking the first eight months of the current business year. The difficulty in marketing the increased output in foreign countries gave rise to a report that the Soviet Government is contemplating development of new domestic uses for the metal. The chief of these new uses may consist of coining platinum chervontzi, or 10-ruble pieces, for circulation throughout the Soviet Union.

Russia's present sales of platinum are at the rate of about 100,000 ounces per annum, according to Wagner.[13] The bulk of the output is at present being obtained by means of big, modern electrically operated dredges, although large quantities of the metal are still being produced by local peasants working on tribute on a small scale and small amounts are also being recovered by crushing and concentration from the primary dunite occurrences of the Urals. At present no crude platinum can be sold in Russia. The whole of the output goes to the State refinery at Sverdlovsk (Ekaterinburg).

SIERRA LEONE [14]

Alluvial platinum is widely distributed in beach and stream gravels in the Peninsula of Sierra Leone and promising deposits have been located in the York district. The platinum occurs in the native state in the form of small nuggets as large and small pitted grains, and as crystals and dust. Two nuggets—one weighing 7.4 grams (4¾ dwt.) and another weighing 1.66 grams—were found by the writer in the branch of the Whale River heading from York Pass, and other nuggets up to about 4 dwt. in size have been found by the mining companies in the course of prospecting. The platinum is associated with large quantities of ilmenite and a little magnetite and scanty chromite. The ilmenite is likely to be a valuable by-product of platinum mining. An analysis made by the Imperial Institute of the crude platinum washed from the Big Water near York Pass gave the following result: Platinum, 87 per cent; osmiridium, 1.3 per cent; palladium,

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[12] Jewelers' Circular, vol. 100, May 29, 1930, p. 41.

[13] Wagner, P. A., The Platinum Deposits and Mines of South Africa: 1929, 326 pp.

[14] Junner, N. R., Geology and Mineral Resources of Sierra Leone: Mining Mag. (London), vol. 42, No. 2, February, 1930, p. 78.

2 per cent; iron, 9.9 per cent. No systematic examination of the rocks for platinum has been made and the alluvial platinum has not yet been traced to its source.

Exclusive prospecting licences aggregating about 20 square miles in area have been taken up for platinum. These licences are now being surveyed and prospected.

UNION OF SOUTH AFRICA

The shipments of platinum in South Africa in 1929 were 21,464 ounces, valued at £221,645, as compared with 17,828 ounces, valued at £241,110, in 1928.

The shipments of osmiridium in 1929 were 5,768 ounces, valued at £89,411, as compared with 5,991 ounces, valued at £86,921, in 1928. Details of the production and sales of osmiridium in 1928 are as follows:[15]

Production and sales of osmiridium in South Africa in 1928, by districts

District	Production (ounces)	Sales	
		Ounces	Value
Witwatersrand:			
Large mines	4, 679. 442	5, 000. 554	£77, 859
Metallurgical works and small mines	936. 350	935. 679	8, 405
Heidelberg	54. 845	54. 750	657
	5, 670. 637	5, 990. 983	86, 921

Composition of osmiridium sold in South Africa in 1928

	Per cent	Weight of metal (troy ounces)		Per cent	Weight of metal (troy ounces)
Osmium	33. 82	2, 026. 051	Gold	1. 16	69. 667
Iridium	28. 88	1, 730. 369	Balance (undetermined)	13. 26	794. 010
Ruthenium and rhodium	12. 83	768. 593			
Platinum	10. 05	602. 203		100. 00	5, 990. 983

In addition to the platinum contained in the osmiridium recovered in the treatment of gold ores, mining for platinum was carried on throughout 1928 in the Potgietersrust and Lydenburg districts. The output of these districts in 1928 follows:

Production of platinum in the Potgietersrust and Lydenburg districts in 1928

	Quantity	Assay	Estimated contents platinum metals (ounces)
Crude platinum	21,883.270 ounces	66.98 per cent	14, 656. 381
Concentrates	811.810 tons	11.09 ounces per ton	9, 006. 527
			23, 662. 908

The production of osmiridium and platinum in South Africa since the beginning of operations is shown in the following table:

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[15] Department of Mines and Industries, Union of South Africa, Annual Report of the Government Mining Engineer for the Calendar Year ended Dec. 31, 1928: Pretoria, 1929.

Production of osmiridium and platinum in South Africa, 1921–1928, in ounces

Year	Osmiridium	Platinum	Year	Osmiridium	Platinum
1921	510		1925	5, 490	
1922	762		1926	6, 228	10, 545
1923	3, 101		1927	5, 473	19, 570
1924	5, 764		1928	5, 671	23, 663

As shown in the foregoing table, the production of osmiridium in South Africa was first recorded in 1921. In that year the recovery of osmiridium, initiated on a small scale at the Modderfontein Deep Levels mine as early as June, 1919, was begun in earnest at several of the larger mines in the Far East Rand.[16] The production in 1921 was 510 ounces, increased to 5,764 ounces in 1924, and during the period 1925 to 1928 averaged about 5,700 ounces.

Almost simultaneously with the beginning of the recovery of osmiridium on a large scale came the opening of the platinum deposits in the Waterberg district of the Transvaal, followed in the latter part of 1924 by the important discoveries in the Lydenburg district of the same province. The first production from these districts was recorded in 1926, when 10,545 ounces of platinum was produced. The Waterberg district had a short-lived and altogether disappointing history, and the Lydenburg district has been reduced to two dunite pipes. During 1925 important discoveries were made in the Potgietersrust field, and shortly thereafter important discoveries were made in the Rustenburg district; it is now generally believed that the Rustenburg district will prove to be the most productive in South Africa.

During 1929 and early in 1930 much literature was published on the platinum fields of South Africa. The references cited [17] therefore include only a few of the important papers published. Space does not permit a review of such literature here, but for details concerning recent developments in South Africa the reader is referred to the references cited. However, the following note concerning the present position and prospects of the South African platinum industry is believed to be of such general interest that it is quoted from the work of Wagner.

> That the South African platinum industry has so far disappointed the more sanguine hopes, originally entertained of it, is undeniable. While it was freely prophesied that by the end of 1928 platinum production from the mines on the Merensky Horizon would be in full swing, it is probable now that it will be well into 1930 before there is a really big output from that source. Delay of this

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[16] Wagner, P. A., Work cited (footnote 13).

[17] Mining and Industrial Magazine (Johannesburg), The Rustenburg Property of Potgietersrust Platinums: Vol. 9, No. 13, Feb. 19, 1930, pp. 535–537.

South African Mining and Engineering Journal, An Important Page in Platinum History: Vol. 40, pt. 1, No. 1974, July 27, 1929, pp. 609–611.

Wagner, P. A. See footnote 13.

Wartenweiler, F., and King, A., The Metallurgy of Transvaal Platinum Ores: Third Empire Min. and Metal. Cong., South Africa, 1930. Papers, 26 pp., 1930.

Richardson, K., Potgietersrust Platinum, Limited: Third Empire Min. and Metal. Cong., South Africa, 1930. Papers, 11 pp., 1930.

Turvey, W. E., The Lydenburg Platinum Areas, Ltd. Maandagshoek Section: Third Empire Min. and Metal. Cong., South Africa, 1930. Papers, 8 pp., 1930.

English, A. A., and Turvey, W. E., Mining Practice as Carried Out on the Oxidized Ore of the Waterval (Rustenburg) Platinum Mining Co., Ltd.: Third Empire Min. and Metal. Cong., South Africa, 1930. Papers, 8 pp., 1930.

kind, however, is inevitable in starting up a new industry under totally new conditions, and, taking everything into consideration, South African mining engineers and metallurgists have every reason to be proud of what has already been achieved.

Nor has the delay been without its compensations. Partly due to it there has, as we shall learn, been a natural weeding out process of all but comparatively few of the more promising of the numerous companies originally floated. The industry is thus at present in a much sounder position than it has been since its inception.

It has already been shown that the ore reserves on the Merensky Horizon in the Rustenburg district are almost unlimited. The reserves in the three known workable dunite deposits are, on the other hand, comparatively very small. Actually the position in regard to the dunite occurrences is as follows.

The Onverwacht Mine will probably be able to maintain an average monthly output of about 400 ounces up to the end of the year when it will be worked out, unless some entirely new strike is made.

The Mooihoek and Driekop mines, belonging to the Lydenburg Platinum Areas, Limited, are in a better position, and should be able to maintain their present output of between 600 and 700 ounces per month for at least five years.

With regard to the Merensky Horizon five companies, all of them more or less equally favorably circumstanced, are actively developing mines in the Rustenburg and Potgietersrust districts. They are—

(1) The Potgietersrust Platinums, Limited, who are conducting operations in the Potgietersrust and Rustenburg districts. In the former they are operating the Zwartfontein Central Mine and the treatment plant already described.

The present output is approximately 4,000 ounces of platinum and palladium per annum, and this output can be maintained indefinitely. At the present time some 300,000 tons of payable ore are actually blocked out ready for stoping above the 100-ft. level.

The Potgietersrust deposits are much wider than those on the Merensky Horizon in the Rustenburg district, but, owing to the occurrence of the ore in irregular shoots they will probably prove to be more difficult and expensive to work.

In the Rustenburg district the company are actively developing the Kroondal-Klipfontein Mine and are erecting a treatment plant on the property. It is estimated that there are in this mine some 3,000,000 tons of workable oxidised ore, the tonnage being estimated over a milling width of only 12 inches; and many times this tonnage of sulphide ore. The development at present in hand will block out a very big tonnage of both oxidised and sulphide ore.

The plant, in process of erection, is designed to produce 28,000 ounces of platinum metals per annum. It is expected to be in commission by the end of 1929.

(2) The Waterval (Rustenburg) Platinum Mining Company, Limited, who are developing a very promising mine on the farm Waterval, adjoining the Rustenburg Town Lands. The total reserve of ore on the Mynpacht and Discovery claims is estimated at nearly 20,000,000 short tons. A treatment plant with a capacity of 10,000 tons of ore per month is being erected.

(3) The Platinum Exploration Company, Limited, who are conducting operations on Swartklip, No. 989, situated 52 miles north-by-west of Rustenburg. The farm is estimated to contain recoverable reserves of ore of the order of 24,000,000 tons. A very considerable tonnage of oxidised and sulphide ore has been opened up, and recent developments at depth have disclosed exceptionally high values. A treatment plant with a capacity of 250 tons of ore per diem is being erected, and should be producing by the middle of 1930.

(4) The Elandsfontein Platinum, Limited, who have opened up a promising mine on the farm Elandsfontein, No. 820, situated 65 miles north-north-east of Rustenburg, and are contemplating the erection of a treatment plant with a capacity of 250 tons per diem.

(5) The Transvaal Consolidated Land and Exploration Company, Limited, who are developing mines on Brakspruit, No. 393, situated east-south-east of Rustenburg, and Boschkoppie, No. 685, situated north-west of Rustenburg. Both are said to be opening up very well.

It should also be stated that the Colonial Mining Development Company, Limited, are opening up what is claimed to be a promising stretch of the Merensky Horizon on the farm Roodekopjes, No. 171, south of Marikana Station.

Assuming that only the four first-named companies proceed with their construction programmes, there will be in existence before the end of 1930 four plants, each capable of producing over 25,000 ounces of platinum metals per annum, in addition to the Potgietersrust plant of the Potgietersrust Platinums, Limited, producing 4,000 ounces per annum, and the Maandagshoek plant of the Lydenburg Platinum Areas, Limited, producing some 8,000 ounces per annum.

South Africa will thus actually be producing, or at least in a position to produce, platinum metals at the rate of well over 100,000 ounces per annum, as against about 17,000 ounces at the present time. There can be no question, moreover, that if these companies achieve success, others will follow with the erection of treatment plants. And, so far as reserves are concerned, it is quite safe to say that South Africa could furnish a very much greater output for an indefinite period.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN STATES [1] [2]

By J. P. Dunlop

SUMMARY

The mines of the Eastern States yielded metals in 1929 valued as follows: Gold, $36,793; silver, $59,515; copper, $5,992,082; and zinc, $21,920,456. There was only one producer of lead, and the Bureau of Mines is not at liberty to publish the figures. Both the quantity and value of each of the five metals, except silver, increased in 1929, compared with 1928.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1920 to 1922 is New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per Pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1920	$1.09	$0.184	$0.080	$0.081	1925	$0.694	$0.142	$0.087	$0.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064
1923	.82	.147	.070	.068	1928	.585	.144	.058	.061
1924	.67	.131	.080	.065	1929	.533	.176	.063	.066

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[1] Work on manuscript completed August, 1930.

[2] Mineral Resources, 1908, Pt. I, pp. 645 to 681, contains references to the geology of the Eastern States and gives a list of the U. S. Geological Survey, State survey, and other publications that deal with the geology and mines of those States; Mineral Resources, 1914, Pt. I, pp. 139 to 163, contains a historical review of the production of gold in the Southern Appalachian States and a list of U. S. Geological Survey publications on gold, silver, copper, lead, and zinc in the Eastern States.

Mine production of gold, silver, copper, lead, and zinc in the Eastern States, 1920–1929

Year	Mines producing	Ore sold or treated (short tons)	Gold (lode and placer)		Silver (lode and placer)	
			Fine ounces	Value	Fine ounces	Value
1920	(1)	2,418,500	411.91	$8,515	112,183	$122,279
1921	27	1,502,277	480.55	9,934	98,792	98,792
1922	29	2,274,175	620.22	12,821	80,935	80,935
1923	21	2,936,637	576.58	11,919	108,799	89,215
1924	16	2,851,932	799.88	16,535	97,628	65,411
1925	19	3,315,912	1,964.60	40,612	106,228	73,722
1926	21	2,902,670	694.23	14,351	106,539	66,480
1927	15	3,201,195	825.96	17,074	84,293	47,794
1928	21	3,770,070	1,697.82	35,097	102,520	59,974
1929	25	4,345,149	1,779.86	36,793	111,660	59,515

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1920	17,138,675	$3,153,516	4,003,078	$320,246	206,764,000	$20,673,444	$24,278,000
1921	15,397,596	1,986,290	----------	----------	135,422,000	10,521,030	12,616,046
1922	15,476,497	2,089,327	1,472,000	80,960	188,082,000	13,616,900	15,881,033
1923	20,487,395	3,011,647	2,500,000	175,000	199,180,000	14,765,885	18,053,666
1924	19,450,329	2,547,993	4,424,000	353,920	212,148,000	16,875,606	19,859,465
1925	20,824,058	2,957,016	5,354,000	465,798	226,814,000	18,531,644	22,068,792
1926	21,567,100	3,019,394	6,500,000	520,000	207,196,000	16,365,050	19,985,275
1927	22,327,734	2,924,933	4,786,000	301,518	236,340,000	16,836,047	20,127,366
1928	29,559,146	4,256,517	(2)	(2)	288,090,000	19,516,228	(2)
1929	34,045,920	5,992,082	(2)	(2)	309,096,000	21,920,456	(2)

[1] Figures not available.
[2] Bureau of Mines not at liberty to publish figures for lead.

GOLD AND SILVER

In the Eastern States the output of gold was $36,793 in 1929 compared with $35,097 in 1928. The output of the gold lode and placer mines, which formerly supplied nearly all the gold, was double that in 1928 but was still only a small part of the total output, as the gold lode mines produced only $894 in gold in 1929 and the placer mines $3,216. The gold ore reported as milled amounted to 3,010 short tons; the yield of gold was small, as the concentrates were not treated. More placer mines were worked, and the yield of gold was about four times that reported for 1928. Placer mines were operated in Alabama, Georgia, and North Carolina and lode gold mines in Georgia and North Carolina. Refining of copper bullion from ore mined in North Carolina, Pennsylvania, and Tennessee yielded $32,683 in gold, of which $3,721 came from North Carolina copper ore, $11,680 from Tennessee copper ore, and $17,282 from Pennsylvania pyritiferous magnetite ore. No gold was reported from copper bullion from Vermont. The value of the estimated production of gold of the Southern Appalachian States for the period 1799 to 1929 is recorded as $51,170,763.

Of the silver (111,660 ounces) produced in the Eastern States in 1929, all except 13 ounces from gold placers and 12 ounces from lode gold mines was derived from copper bullion recovered from copper ore and pyritiferous magnetite ore; the pyritiferous magnetite ore carries much less silver than the copper ore.

Mine production of gold and silver in the Eastern States in 1929, by States

State	Gold		Silver		Increase or decrease in value as compared with 1928	
	Fine ounces	Value	Fine ounces	Value	Gold	Silver
Alabama	9.82	$203	1	$1	+$203	+$1
Georgia	124.52	2,574	16	9	+1,663	+6
North Carolina	244.48	5,054	21,106	11,249	+2,688	+104
Pennsylvania	836.02	17,282	5,972	3,183	−3,224	−1,441
South Carolina					−197	−1
Tennessee	565.02	11,680	81,281	43,323	+563	−878
Vermont			3,284	1,750		+1,750
	1,779.86	36,793	111,660	59,515	+1,696	−459
Total, 1928	1,697.82	35,097	102,520	59,974		

Mine production of gold and silver in the Eastern States in 1929, by sources, in fine ounces

State	Gold			Silver		
	Placers	Dry and siliceous ore	Copper ore	Placers	Dry and siliceous ore	Copper ore
Alabama	9.82			1		
Georgia	93.27	31.25		8	8	
North Carolina	52.48	12.00	180.00	4	4	21,098
Pennsylvania			836.02			5,972
Tennessee			565.02			81,281
Vermont						3,284
	155.57	43.25	1,581.04	13	12	111,635
Total, 1928	39.67	54.18	1,603.97	3	16	102,501

COPPER

The mine production of copper in the Eastern States in 1929 was 34,045,920 pounds, valued at $5,992,082, an increase of 4,486,774 pounds over 1928. The output was derived from copper ore mined in North Carolina, Tennessee, and Vermont and from copper concentrates recovered from Pennsylvania pyritiferous magnetite ore mined for its iron content. Exclusive of the magnetite ore, which yielded about 2.7 pounds of copper to the ton, the average yield of copper from copper ore was 1.65 per cent, or 32.9 pounds to the ton. The copper ore also yielded $0.08 in gold and silver to the ton. The copper concentrates from magnetite ore contained about 21.8 per cent of copper and $2.58 in gold and silver to the ton. Copper ore directly smelted amounted to 438,202 short tons, from which 19,212,680 pounds of copper was recovered. Copper and magnetite ores concentrated amounted to 1,861,323 short tons and yielded 50,660 tons of concentrates, from which 14,833,240 pounds of copper was recovered.

LEAD

The only output of lead reported from the Eastern States in 1929 was from the Austinville mine in Virginia, as the Embree mine in Tennessee shipped no lead ore. The production was derived from lead-zinc ore and was larger than in 1928. The Bureau of Mines is not at liberty to publish the figures for 1928 and 1929.

ZINC

The recoverable zinc in the ore mined in the Eastern States in 1929 was valued at $21,920,456.

[N. B.—The value of the zinc in New Jersey is not that of ore mined. It is the estimated smelting value of the recoverable zinc content of the ore after freight, haulage, smelting, and manufacturing charges are added.]

In 1929, 789,552 short tons of zinc ore was mined in New Jersey and 682,680 tons in Tennessee, and 149,183 tons of crude ore and old tailings were treated in New York. Nearly all the ore mined in Virginia was lead-zinc sulphide ore. All the zinc ore and lead-zinc ore mined in New York, Tennessee, and Virginia went to concentrating plants; part of the New Jersey ore was not concentrated. The recoverable zinc, as metal or in oxide, in the ore and old tailings from New York in 1929 was 20,500,000 pounds; Tennessee and Virginia contributed 81,116,000 pounds of zinc.

REVIEW BY STATES

Alabama.—The value of the gold produced in Alabama during the period 1830 to 1929 is recorded as $766,949. The only productive gold mine operated in 1929 was that of A. H. Quinn, in Cleburne County, near Oxford; the gold was recovered during development work.

Georgia.—The value of the gold produced in Georgia during the period 1830 to 1929 is recorded as $17,847,658, or more than one-third of the estimated total output of the Southern Appalachian States. In 1929, 5 placer mines and 2 lode mines yielded $2,574 in gold and 16 ounces of silver, compared with $911 in gold and 5 ounces of silver in 1928. The gold produced in 1929 came from properties near Dahlonega and Auraria in Lumpkin County and near Washington in Wilkes County. The properties in Lumpkin County reporting gold recovered were the Boyd, Calhoun, Liberty Bell, and Dixie. Most of the gold from lode gold mines was from the Stoney Ridge mine in Wilkes County, belonging to A. J. Orr; this mine has a 40-foot shaft and about 200 feet of drifts and is equipped with a 10-stamp mill and concentrating tables. The concentrates were not treated in 1929.

Maine, Maryland, New Hampshire, and Vermont.—No production of gold, silver, or copper was reported for 1929 from any of the mines in Maine, Maryland, or New Hampshire. The estimated total gold production of Maryland has been $71,405, virtually all of which was produced prior to 1906. The old Elizabeth mine at South Strafford, Orange County, Vt., was taken over by the National Copper Co. and operated for 8 months. The 150-ton flotation concentrating plant was completely rebuilt and its capacity increased to 300 tons. The pyrrhotite and chalcopyrite ore body is mined through a 1,500-foot adit, a 900-foot inclined shaft, and 3,000 feet of drifts. In addition to the copper the concentrates yield about 1½ ounces of silver a ton.

New Jersey (see also note above).—The production of zinc ore in New Jersey in 1929 was 789,552 short tons; the ore contained 207,480,000 pounds of recoverable zinc. All the ore mined was treated by the producer for the recovery of metal and oxide.

New York.—The quantity of zinc ore mined in New York in 1929 was 81,475 short tons and old tailings re-treated, 67,708 tons; the concentrates recovered yielded 20,500,000 pounds of zinc. The St. Joseph Lead Co. property is equipped with a 500-ton flotation plant, which was operated steadily. The ore was mined from a maximum depth of 1,500 feet by means of one shaft; another shaft was utilized for supplies and mine labor. The exploration done in 1929 opened a new ore body, which is to be developed; a new mill will be erected in 1930.

North Carolina.—The value of the gold produced in North Carolina during the period 1799 to 1929 is recorded as $23,668,507. The yield of gold increased from $2,366 in 1928 to $5,054 in 1929. Placer mines and gold lode mines yielded $1,333 in gold; the remainder was derived from copper bullion. The output of placer gold was from Nash and Stanly Counties. The mine in Nash County operated by W. L. Long, of Roanoke Rapids, is worked by sluicing and stamp milling. The Leeper hydraulic mine near Belmont in Gaston County was being prepared for operation in 1930. Considerable development work was done on the Black Ankle mine in Montgomery County, near Seagrove, in 1929; this work included surface stripping, a 50-foot shaft, and 130 feet of drifting. The new 150-ton washing plant was operated for about 60 days in 1929. Very little gold was marketed in 1929, but 250 tons of concentrates are ready for treatment. The North Carolina Flux Co. operated the old Cullowhee mine near East Laport in Jackson County and shipped some copper ore to the Tennessee Copper Co. smelter. The mine, which is not equipped with a milling plant, is opened by a 175-foot shaft and 2,000 feet of drifts. The Rich Cog and Iola mines, both in Montgomery County, were not operated. Repair work only was accomplished at the Gold Hill mine, in Rowan County, which is under lease to H. H. Green. The Fontana copper mine in Swain County continued to ship crude copper ore to the Ducktown Chemical & Iron Co., at Isabella, Tenn., for smelting. The copper bullion from this mine yielded most of the gold and silver credited to North Carolina in 1929.

Pennsylvania.—The Cornwall iron mines in Lebanon County were continuously operated by the Bethlehem Mines Corporation and yielded 7,940 short tons of copper concentrates from pyritiferous magnetite. The tailings from the iron concentrates go to the flotation plant, where they are ground to 65 mesh and floated. The copper concentrates, shipped to eastern smelters, contained about 22 per cent of copper and $2.58 to the ton in gold and silver. The gold recovered from these concentrates was about 47 per cent of the total from all mines in the Eastern States in 1929. The silver content of the copper concentrates is less than 1 ounce to the ton.

South Carolina.—Mines in South Carolina yielded $5,182,815 in gold during the period 1829 to 1929. No output of gold was reported for 1929, nor was any development reported at gold mines.

Tennessee.—Mines in Tennessee produced $334,993 in gold during the period 1831 to 1929. Most of the output prior to 1879 was from placer mines in Monroe County, but the production from 1906 to 1927 and that in 1929 came entirely from copper ores mined in Polk County; a little gold was recovered from placers in 1928. There were increases in 1929 in the quantity and value of gold, copper, and zinc, especially in copper and zinc. There were no shipments of lead ore in 1929.

Mine production of gold, silver, copper, lead, and zinc in Tennessee, 1920–1929

Year	Ore sold or treated	Gold	Silver	Copper	Lead	Zinc	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1920	1,120,995	$5,830	110,719	16,727,803	3,957,000	38,434,000	$6,634,144
1921	889,122	4,920	98,762	15,084,294	------------	19,384,000	3,018,756
1922	983,844	4,320	78,341	14,240,571	1,464,000	31,136,000	3,860,410
1923	1,355,547	6,615	105,712	18,721,932	2,500,000	31,800,000	5,182,823
1924	1,443,159	6,800	94,779	18,335,635	1,874,000	28,752,000	4,491,070
1925	1,711,298	7,421	102,949	19,788,234	896,000	32,512,000	5,437,660
1926	1,114,400	8,622	104,000	18,606,664	1,600,000	24,196,000	4,621,151
1927	1,152,155	8,816	81,460	14,940,595	------------	20,800,000	3,343,421
1928	1,330,194	11,117	75,558	16,374,261	------------	[1] 65,834,000	[1] 6,429,086
1929	1,507,980	11,680	81,281	(2)	------------	[1] 81,116,000	(2)

[1] Includes zinc from Virginia, for which Bureau of Mines is not at liberty to publish figures.
[2] Bureau of Mines not at liberty to publish figures for copper.

The entire output of copper, gold, and silver in Tennessee in 1929 came from two properties in the Ducktown district. The Annette mine on Coker Creek in Monroe County did not report any placer gold.

The Tennessee Copper Co. ran its 900-ton flotation plant, 1,500-ton blast furnace, Pierce Smith converter, sulphuric acid plant, and copper sulphate works on sulphide ore from the Burra Burra and Eureka mines.

The Ducktown Chemical & Iron Co. operated its 600-ton flotation plant, 600-ton blast furnace, and one converter on sulphide ore and concentrates from the Isabella and East Tennessee mines. The crude ore from the Fontana mine in North Carolina was also treated at the Ducktown smelter.

The Grasselli mine at New Market was idle in 1929.

The Universal Exploration Co. continued to develop its property by means of shafts and drifts. The ore shipped in 1929 was all zinc carbonate ore, mined at levels between 20 and 50 feet and sold to zinc oxide plants. The screen picking belt, jigs, etc., can handle 100 tons a day. In 1930 the property will be equipped with a 500-ton plant designed to treat the ore in sulphide ore bodies developed at lower levels.

The Embree Iron Co. in Washington County continued to develop carbonate ores; it shipped a considerable quantity of zinc carbonate but no lead carbonate.

Operations at the Mascot mine of the American Zinc Co. of Tennessee were on a larger scale than in 1928. The Mascot mine is equipped with two 700-foot shafts and a 2,500-ton flotation-concentration plant. The Jarnegan property at Jefferson City was placed on an operating basis in August, 1929. A limited tonnage of ore was shipped to Mascot from the Jarnegan, while drifting and drill prospecting continued.

Virginia.—The value of the gold produced from mines in Virginia during the period 1828 to 1929 is recorded as $3,298,436, of which only about $9,200 was produced during the last 19 years. No production of gold has been reported from Virginia since 1926. The production of both lead and zinc increased in 1929. There were only one producer of lead and two producers of zinc, and the Bureau of Mines is not at liberty to publish the figures. Sulphide lead-zinc ore was treated by the Bertha Mineral Co. at its Austinville 1,500-ton mill which ran steadily during 1929. The Ivanhoe Mining & Smelting Corporation sank several shallow shafts to an average depth of 60 feet and shipped several hundred tons of oxidized zinc ore.

RARE METALS[1]

By PAUL M. TYLER and ALICE V. PETAR[2]

COBALT

GENERAL CONDITIONS

In 1929, as in a number of preceding years, the United States produced no cobalt, and consumption was represented more or less closely by imports. During the last 10 years imports have been as follows:

Cobalt ore, cobalt, and oxide imported for consumption in the United States, 1920–1929

Year	Ore		Cobalt		Oxide		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1920	13,039	$4,794	143,603	$326,864	202,724	$399,605	[1] 359,586	[1] $731,277
1921	7,657	3,235	38,442	105,539	164,003	342,426	210,102	451,200
1922	5,195	7,075	126,364	321,396	217,530	435,895	[2] 349,089	[2] 764,366
1923	58,719	56,326	225,639	552,434	258,574	511,903	[2] 542,932	[2] 1,120,663
1924	28,786	37,276	118,952	264,935	226,703	440,898	[2] 374,441	[2] 743,109
1925	34,782	31,320	198,669	422,185	287,265	546,292	[2] 520,716	[2] 999,797
1926	154,468	55,820	387,076	820,873	333,132	632,478	[1, 2] 874,786	[1, 2] 1,509,211
1927	60,382	3,019	407,198	841,442	369,747	703,608	[2] 837,327	[2] 1,548,069
1928	107,498	25,922	535,817	1,147,574	364,154	692,753	[2] 1,007,469	[2] 1,866,249
1929	434,443	51,862	806,640	1,743,465	475,928	884,873	[2] 1,717,011	[2] 2,680,200

[1] Includes 220 pounds of zaffer, valued at $14, in 1920, and 110 pounds, valued at $40, in 1926. No zaffer imported 1921 to 1925 and 1927 to 1929.

[2] Also 11 pounds of "other salts and compounds," valued at $26, imported Sept. 22 to Dec. 31, 1922. Not separately classified prior to change in tariff. Similar additional imports in 1923 were 45,644 pounds, valued at $27,356; in 1924, 797 pounds, $856; in 1925, 13,256 pounds, $7,894; in 1926, 37,342 pounds, $21,647; in 1927, 55,127 pounds, $28,681; in 1928, 68,281 pounds, $39,993; and in 1929, 64,782 pounds, $37,548.

Cobalt compounds imported for consumption in the United States, 1926–1929

	1926		1927		1928		1929	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Linoleate	2,522	$952	---	---	---	---	---	---
Sulphate	34,466	20,163	55,045	$28,617	68,150	$39,791	60,596	$34,893
Other salts	354	532	82	64	131	202	4,186	2,655
	37,342	21,647	55,127	28,681	68,281	39,993	64,782	37,548

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[1] Work on manuscript completed June, 1930.

[2] Statistics on domestic production prepared by H. W. Davis and figures on foreign production compiled by L. M. Jones, both of the Bureau of Mines. Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Cobalt and cobalt ore imported into the United States, 1927–1929, by countries

[General imports]

Country	1927		1928		1929	
	Pounds	Value	Pounds	Value	Pounds	Value
Africa, British West			6,832	$200		
Australia			88,200	13,822	209,420	$33,413
Belgium	205,211	$455,799	260,900	611,596	498,749	1,159,426
Canada	223,291	312,774	217,586	404,370	499,758	533,087
Chile			6,164	3,897		
Germany	39,078	75,888	63,633	139,611	33,156	69,401
	467,580	844,461	643,315	1,173,496	1,241,083	1,795,327

During 1929 the Belgian, Canadian, and British operators continued their close control of the supply and price of cobalt. A little cobalt was imported from Germany, but the quantity was insignificant in comparison with other cobalt imports.

Imports of cobalt and cobalt ore during 1929 amounted to 1,241,083 pounds—nearly double those of 1928. Australia supplied the United States with nearly two and one-half times as much cobalt in 1929 as in 1928, and imports from Belgium and Canada were about twice as great as in 1928.

The Belgian supply is obtained from veins carrying cobalt, copper, and iron sulphides near Elisabethville, Katanga, Belgian Congo. The greater part of the Canadian supply is a by-product of the silver-mining industry. The cobalt is recovered by treating arsenical silver-cobalt-nickel residues from the Cobalt, South Lorrain, Gowganda silver camps. Part of the British supply is mined from cobalt arsenosulphide veins in the Cloncurry district of Queensland; the remainder is saved as a by-product from nickel ores that are mined near Sudbury, Ontario, and treated by the Mond process at Clydach, Wales.

According to a note in the Mining Journal of London[3] the output of cobalt in Yunnan, China, approximates 200 tons a year. Presumably the production is in the form of rather low-grade ore, which is made into smalt or other compounds used in the pottery trade. The output is mainly exported to Kwangsi at a price ranging from $200 to $300 a ton.

The price was held at $2.10 throughout 1929 for the black oxide and at about $2.50 to $3 per pound for the metal, f. o. b. Deloro, Ontario. The London quotations were 8s. for black oxide, 8s. 10d. for the gray oxide, and 10s. per pound for metal, equivalent to $1.94, $2.15, and $2.43, respectively.

Increasingly large quantities of cobalt are being used in stellite and in the new tungsten carbide tools, and many new cobalt alloys for use in telephone circuits, high-speed tools, springs, and electrical conductors have been patented within the last year or two. During the year the Westinghouse Electric & Manufacturing Co. announced the development of a new alloy of cobalt, nickel, and ferrotitanium to which the name "Konel" was given. The metal is claimed to be much stronger than other metals at high temperatures and to be suitable for use in the moving parts of internal-combustion engines and other extremely hot places. Konel was originally developed as a substitute for platinum in the manufacture of filaments for radio tubes but was found to be harder to forge than steel and to be very tough at high temperatures.

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[3] Mining Journal (London), Mining in Yunnan, China—Cobalt: Vol. 167, Nov. 2, 1929, p. 891.

Organic cobalt salts are used for driers in paint, and some cobalt is used as pigment in pottery and enamels.

WORLD PRODUCTION

The production of cobalt is given from the several producing countries in such indefinite figures that the estimates are not very exact, but from various official reports the following data have been compiled.

World production of cobalt, 1927–1929, in metric tons

Country	Cobalt-bearing material	1927		1928		1929	
		Gross weight	Cobalt content	Gross weight	Cobalt content	Gross weight	Cobalt content
Australia: Queensland	Cobaltite concentrates, etc.	--------	--------	40	8	(1)	20
Belgian Congo	Copper-iron-cobalt alloy	2,100	[2] 558	(1)	[3] 450	(1)	[3] 700
Canada: Ontario	Cobalt, alloys, and chemicals	(1)	399	(1)	434	(1)	422
Chile	Arsenosulphide ore	3	(4)	11	2	(1)	(1)
China: Yunnan	(1)	[2] 250	(1)	[2] 250	(1)	[2] 200	(1)
Germany: Saxony	Cobalt-bismuth-nickel ores	92	(1)	82	(1)	(1)	(1)
India, British: Burma [5]	Cobaltiferous nickel speiss	4,770	167	3,878	136	3,834	134
New Caledonia	Concentrates [6]	[7] 78.6	[2] 3.5	(1)	(1)	(1)	(1)
		--------	(1)	--------	(1)	--------	(1)

[1] Data not available.
[2] Estimated.
[3] Cobalt in metal, oxide, and salts produced at Oolen, Belgium.
[4] Less than 1 ton (471 kilograms).
[5] Year ended June 30 of year stated.
[6] Cobalt-bearing manganese oxide.
[7] Exports.

BIBLIOGRAPHY

Of the literature on cobalt appearing or becoming available during 1929, which has come to the attention of the Bureau of Mines, the following articles seem worthy of notice.

BELL TELEPHONE LABORATORIES. Magnetic alloys of cobalt and iron. British Patent 297938, August 29, 1927. Chem. Abs., vol. 23, June 10, 1929, p. 2692.

"Magnetic alloys of high permeability contain iron and 40–60 per cent Co and are heat treated to give them a permeability above that of Armco iron at a corresponding magnetizing force (suitably by heating at about 1,100° 2–3 hours and then slowly cooling)."

CHESTERFIELD, PERCY C. (to Chesterfield Metal Co.). Alloys suitable for high-speed tools. U. S. Patent 1698934, January 15, 1929. Chem. Abs., vol. 23, March 10, 1929, p. 1103.

"Alloys are formed containing Ni and Co which together constitute about 40 per cent of the alloy, together with about 30 per cent each of Cr and W and some C (suitably about 0.5–3.5 per cent)."

CORSON, MICHAEL G. (to Electro Metallurgical Co.). Copper-cobalt alloy. U. S. Patent 1723922, August 6, 1929. Chem. Abs., vol. 23, September 20, 1929, p. 4435.

"The physical strength of Cu is improved by alloying it with Co 2–5 per cent, heating the alloy to above 850° and quenching from that temperature."

DUDGEON, W. F. H. Important gold-cobalt occurrence. South African Mining and Engineering Journal, vol. 40, 1929, p. 113.

ELMEN, G. W. Magnetic alloys of iron, nickel, and cobalt. J. Franklin Inst., vol. 207, 1929, pp. 583–617. Chem. Abs., vol. 23, September 10, 1929, p. 4177.

"After a brief historical sketch of the work done on ferromagnetic alloys since 1913, the properties peculiar to the permalloys (Fe-Ni alloys with more than 30

per cent Ni) and the perminvars (Ni 45 per cent, Co 25 per cent, Fe 30 per cent) are discussed at length. The effects of varying the proportions of the various components, annealing, quenching, etc., on the initial permeability, maximum permeability, hysteresis loss, intrinsic induction, resistivity, etc., are presented in a series of three-dimensional plots. The effects of various heat treatments are considered in detail and an explanation is offered on the theory of segregation, although it is recognized that this does not account for the high permeabilities at low fields. The possibility of the formation of a compound such as $FeCO_2$ is also considered. A brief account of the applications of these alloys in telephone circuits is included."

Hiessleitner, G. Das Nickelkobalterzvorkommen Zinkwand-Vöttern in den Niederen Tavern bei Schladming. (The nickel-cobalt deposits of Zinkwand-Vöttern in the Nieder Tavern near Schladming.) Berg u. Hüttenm. Jahrb. Leoben, vol. 77, 1929, pp. 104–123.

——— Sulfidisch-arsenidisches Ni-Co auf alpinen Erzlagerstätten. (Sulphide-arsenide Ni-Co in the Alpine ore deposits.) Ztschr. f. prakt. Geol., Jahrg. 37, 1929, pp. 152–159.

Holgersson, S., and Karlsson, A. Ueber einige neue Kobaltite vom Spinelltypus. (Some new cobaltites of the spinel type.) 11 pp. Leipzig, 1929. (Excerpt from Ztschr. f. anorg. u. allgem. Chem., vol. 183, No. 4, 1928.)

Hoyt, Samuel L. Carboloy (tungsten-cobalt-carbide), a new tool material. Gen. Elec. Rev., vol. 31, 1928, pp. 585–91. Chem. Abs., vol. 23, January 10, 1929, p. 42.

"A discussion of the characteristics of certain W-carbide tool materials, which have been given the trade name of 'carboloy.' The hardness is between that of natural sapphire and the diamond. Means of measuring its hardness and comparing with other hard materials are outlined. Carboloy is featured by low thermal expansion and thermal conductivity, great chemical stability, and retention of strength and hardness at elevated temperatures. It will take and retain a sharp cutting edge. A number of unusual applications of carboloy as a cutting tool are given. These include making of certain alloys of Cu-Sn-C, commutators of electric motors consisting of alternate layers of Cu and mica, insulating materials, bakelite, etc."

Scherer, A. Influence of cobalt, vanadium, and manganese on some properties of tool steel. Arch. Eisenhuttenwes., vol. 1, 1927, pp. 325–9. Chimie et industrie, vol. 20, 1928, p. 667. Chem. Abs., vol. 23, February 10, 1929, p. 585.

"The tests were carried out on eutectoid C steels containing increasing amounts of Mn, V, V and Si, Co, V and Co. Co steels were least affected by variations in quenching conditions, and particularly unaffected by excessive heating. They also exhibited least change in volume on quenching. The steels best suited for making tools are Co and V steels, which have both maximum hardness and minimum sensitiveness to hardening treatment."

Schulte, Louis (to Allegheny Steel Co.). Electroplating with cobalt chromium alloys. U. S. Patent 1717468, June 18, 1929. Chem. Abs., vol. 23, August 20, 1929, p. 3862.

"In forming the plating bath a portion of a solution formed from Co sulphate 50–75, Na_2SO_4 30–40, HF 5–15, and water about 250 parts is mixed with a larger proportion of a solution formed from chromic acid 75, KOH 3, H_2SiF_6 10, and water about 250 parts."

Smith, W. S., Garnett, H. J., and Holden, J. A. Magnetic alloys. British Patent 302394, September 16, 1927. Chem. Abs., vol. 23, September 10, 1929, p. 4183.

"An alloy suitable for use as tape or wire for loading signaling conductors comprises Ni and Co with not less than 5 per cent Mn. Up to 6 per cent of one or more of the elements Cr, Mo, W, Si, V, or Al may be added to increase the electrical resistance. Wire formed of the alloy may be heated at 900° and cooled in air."

Von Kantzow, H. G. A. Heat-resisting ferrous alloys. British Patent 298408, December 10, 1927. Chem. Abs., vol. 23, June 10, 1929, p. 2692.

"Fe alloys are formed containing Al 0.5–14 per cent and up to 6 per cent of Co or of Co and Ti together, with or without addition of Cr up to 30 per cent or Mn up to 12 per cent, or both."

Von Kantzow, H. G. A. Alloy. Canadian Patent 284524, November 6, 1928. Chem. Abs., vol. 23, February 20, 1929, p. 812.

"A fire-resistant alloy with high electrical resistance contains as principal constituents Fe with Al 1–5 per cent, Co 1–6 per cent or Al 1–5 per cent, Cr 5–22 per cent and Co 1–4 per cent. The addition of Co alone or together with Ti to alloys of this type, especially those containing Cr, increases the fire resistance by several hundred per cent and the electrical considerably, for instance, by about 20 per cent or more."

MOLYBDENUM

DOMESTIC PRODUCTION

During 1929 a total of 419,400 short tons of ore was milled in the United States, yielding 3,854 tons of concentrates, carrying from 75.40 to 88.33 per cent molybdenum sulphide. In addition, a small tonnage of ore carrying 16 per cent of molybdenum sulphide was produced and sold without milling. The metallic molybdenum content of the concentrates and ore so produced was 4,020,607 pounds, an increase of 17 per cent over 1928. The shipments of concentrates and ore from the mines contained an equivalent of 3,904,648 pounds of elemental molybdenum, valued, more or less arbitrarily, at $2,259,000 at the mines.

Four companies produced molybdenum ore during 1929—the Climax Molybdenum Co., at Climax, Colo.; the Molybdenum Corporation of America, at Sulphur Gulch, near Questa, N. Mex.; the Southern Copper Mining Co., at Helvetia, Ariz.; and the Minerals & Metals Corporation, near Sahuarita, Ariz.

The Climax Molybdenum Co., the largest producer of molybdenum in the world, increased its output during 1929 considerably over that of the previous year. The plant was enlarged by the construction of a new unit, having a capacity of 700 tons of ore daily, which brings the total capacity of the plant to 2,000 tons daily. Further extensions of the crushing plant and a new tunnel at a lower level have been made with a view to adding two additional units, thereby increasing the capacity to about 4,000 tons of ore daily, or approximately 6,000,000 pounds of molybdenum a year.

The Molybdenum Mines Co., of Yakima, Wash., was organized during the summer of 1929 to prospect properties at Omak in Okanogan County and on the east side of Mount Rainier at Deep Creek, in Yakima County. At Omak a large low-grade ore body believed to average about 1 per cent of molybdenum has been opened up; the molybdenite occurs in a gneissic rock containing also 3 or 4 per cent of graphite. Only assessment work was done in 1929 at Deep Creek, where molybdenite was discovered in 1922 during prospecting for gold; high-grade ore containing up to 57 per cent of molybdenum occurs on this property in veins. No production was reported during 1929. The Molybdenum Corporation of America ceased work at Tonasket, Wash., late in 1928.

Data on the production of molybdenum in the United States during the last 10 years are given in the following table:

Molybdenum in ore and concentrates, produced in the United States, sold in 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	34,900	$17,207	1925	1,154,050	[2] $961,324
1921			1926	(3)	(3)
1922			1927	2,286,075	1,858,786
1923	22,667	(1)	1928	3,329,214	1,924,600
1924	297,174	(1)	1929	3,904,648	[2] 2,259,000

[1] Value not reported.
[2] Estimate by Bureau of Mines.
[3] Bureau of Mines not at liberty to publish figures.

Calcium molybdate was quoted throughout 1929 at 95 cents to $1 per pound of contained Mo.

IMPORTS AND EXPORTS

The imports since 1920 are shown in the following table.

"Molybdenum ore[1] (steel-hardening)" imported for consumption in the United States, 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	15,639	$9,707	1925 [2]	1,954	$1,793
1921	29,783	20,471	1926 [2]	13,397	11,175
1922	412,221	90,015	1927 [2]	12,541	10,472
1923 [2]	16,671	13,115	1928		
1924 [2]	10,379	9,038	1929		

[1] 1920–1922, recorded as molybdenum ore; 1923–1929, recorded as molybdenum content of ore.
[2] Classification under tariff of Sept. 22, 1922, "Molybdenum ore and concentrates (molybdenum content)."

About two-thirds of the world's consumption of molybdenum is in the United States and one-third in Europe. Imports of molybdenum ore have virtually ceased, while exports have grown to substantial proportions. Figures on exports of molybdenum ore are not separately recorded by the Bureau of Foreign and Domestic Commerce. American molybdenite concentrates are made into calcium molybdate and ferromolybdenum in Germany, France, and England.

WORLD PRODUCTION

The accompanying table shows the world production of molybdenum in 1928 and such data as are obtainable for 1929. The table has been compiled from available official reports.

World production of molybdenum ores and concentrates, 1928 and 1929

Country [1]	Mineral	Ore	Concentrates	Per cent MoS_2	Contained molybdenum	Value
1928		*Metric tons*	*Metric tons*		*Metric tons*	
Australia: New South Wales	Molybdenite	(2)	2	(2)	(2)	$1,898
Austria	Wulfenite	(2)	(2)	(2)	3.3	(2)
Chile	Molybdenite	(2)	(2)	(2)	(2)	(2)
Chosen	do	(2)	31	(2)	(2)	17,780
Morocco, French	do	(2)	[3] 1	(2)	(2)	745
Norway	do	(2)	216	78	101	190,283
Russia [4]	do	(2)	(2)	(2)	(2)	(2)
United States	do	298,452	3,098	83.66	1,555	1,981,700
1929						
Australia: New South Wales	Molybdenite	(2)	.6	(2)	(2)	223
Austria	Wulfenite	(2)	(2)	(2)	2.6	(2)
Canada	Molybdenite	(2)	15	85	7.7	(2)
Chile	do	(2)	(2)	(2)	(2)	(2)
Chosen	do	(2)	30	(2)	(2)	15,642
Morocco, French	do	(2)	[3] .7	(2)	(2)	509
Norway	do	(2)	(2)	(2)	(2)	(2)
Russia [4]	do	(2)	(2)	(2)	(2)	(2)
United States [5]	do	380,471	3,496	75.40–88.33	1,824	2,321,000

[1] In addition to the countries listed, Mexico is a producer of molybdenite, but data of output are not available for the years under discussion.

[2] Data not available.

[3] Exports.

[4] Year ended Sept. 30.

[5] In addition to the ore milled, a small quantity of ore, averaging 16 per cent MoS_2, was sold crude.

Canada.—There was evidence of considerable activity in the development of Canadian molybdenum properties during 1929. The first commercial production of molybdenite in Canada dates back to 1902, when a shipment of 3 to 4 tons of ore was made from the Horscroft mine in Victoria County, Ontario. In the following year 85 short tons of ore, valued at $1,275, was shipped from the Chisholm mine in Sheffield Township, Ontario. Apparently no more molybdenum was produced in the Dominion until 1914, when the output amounted to 16.5 tons of ore, valued at $2,063. The industry grew rapidly during the war period, and shipments of molybdenite in 1916, 1917, and 1918 were 610 tons, 1,554.3 tons, and 461.3 tons, respectively. After the armistice the industry dwindled to negligible proportions, and only now appears again to be showing signs of life. During 1929 the Molybdenite Reduction Co. constructed a 100-ton mill at its property about 25 miles south of Amos, Abitibi County, Quebec. The ore treated probably averaged about 1 per cent of molybdenite, the recovery being over 90 per cent, and 17 tons of molybdenite concentrates were shipped. Toward the end of the year the Hollinger Consolidated Gold Mines (Ltd.) took a working option on the property. In British Columbia development work was carried on by the Dalhousie Mining Co. (Ltd.) at the Alice Arm molybdenite property east of Anyox in the Skeena Mining Division, and by the Dominion Mineral Development Co. on a series of quartz-molybdenite veins in the Coquihalla area, near Iago.

Toward the end of the year the Superior Alloys (Ltd.) undertook construction of an addition to its plant at Sault Ste. Marie, Ontario, for the manufacture of calcium molybdate. It was expected that the unit would be ready for operation within six months.

Australia.—Early in the year a discovery of molybdenum ore was reported at Mount Remus, in the west coast district of Tullah, Tasmania.

USES

Molybdenum, chiefly in the form of calcium molybdate, is used principally in the manufacture of special steels. The annual production of molybdenum-treated steel and iron increased from about 25,000 tons in 1918 to 400,000 tons in 1928 and probably exceeded 450,000 tons in 1929. These steels are used extensively in aircraft and in automobiles, and they are fabricated into bearings, steel castings, and in corrosion and high-temperature resisting alloys for many purposes. Many of the new steels contain as much as 1.25 or 2 per cent of molybdenum. In gray-iron foundries molybdenum is added to the cupola in the form of ferromolybdenum. Next to steel, radio tubes constitute the largest outlet for molybdenum; a surprisingly large tonnage of molybdenum wire and sheet is used in the radio industry. A considerably smaller but nevertheless fairly substantial quantity of molybdenum is consumed in the manufacture of chemicals and dyes.

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The following articles on molybdenum are among those that appeared or became available during 1929.

Alterthum, H. Molybdenum and its uses. Ztschr. angew. Chem., vol. 42, 1929, pp. 2–11. Chem. Abs., vol. 23, April 20, 1929, p. 1848.

"A review of recent progress in the field of Mo, its occurrence, metallurgy, properties, uses and economics, with a bibliography."

Balke, Clarence W. Metals of the tungsten and tantalum groups. Ind. and Eng. Chem., vol. 21, November, 1929, pp. 1002–1007.

Becket, Frederick M. (to Electro Metallurgical Co.). Alloy of molybdenum, nickel and iron. U. S. Patent 1710445, April 23, 1929. Chem. Abs., vol. 23, June 10, 1929, p. 2692.

"An alloy which is acid-resistant comprises Ni at least 40, Mo 15–40 and a quantity of Fe not less than 10 per cent nor greater than 5 times the amount by which the Mo per cent exceeds 10."

Bell Telephone Manufacturing Co. Magnetic alloy. Swiss Patent 12601, December 31, 1926. Chem. Abs., vol. 23, February 20, 1929, p. 813.

"An alloy susceptible to small magnetic impulses comprises Ni 78, Fe 18–19, and Mo 4–3 per cent."

Carobbi, G. Chemical and spectrographic studies on Tasmanian crocoite and wulfenite from Bleiberg. Ann. chim. applicata, vol. 18, 1928, pp. 485–94. Chem. Abs., vol. 23, April 20, 1929, p. 1843.

"The wulfenite was found to contain, besides W, many rare earths with La predominating, and considerable Ce. The crocoite was also found to contain these rare earths, La again predominating. Traces of many others, such as Ga, Eu, Nd and Y were noted."

Chemistry and Industry. Developments in the uses of molybdenum. Vol. 48, March 29, 1929, p. 315.

Chesterfield, Percy C. (to Chesterfield Metal Co.). Alloy for high-speed tools. U. S. Patent 1698935, January 15, 1929. Chem. Abs., vol. 23, March 10, 1929, p. 1103.

"Alloys are formed containing Co 15–5, Ni 7–30, Cr 20–45, and Mo 7–35 per cent together with a small quantity of C (suitably about 0.5–3.5 per cent)."

Climax Molybdenum Co. Alloys. British Patent 299800. Metal Industry (London), vol. 34, January 4, 1929, p. 17.

"A molybdenum compound, such as molybdenum oxide or sulphide, or calcium molybdate, is added to the charge of a blast furnace in such proportions as to yield a pig iron containing a desired percentage of molybdenum. Molybdenum-

bearing pig iron so produced may be mixed with other molten iron, or melted with other iron, or may be mixed with molten metal in a steel-making furnace, or may form part of the charge of a cupola furnace, for the production of gray, white, malleable or semisteel castings."

Climax Molybdenum Co. Ferrous molybdenum alloys. British Patent 314032, June 19, 1928. Chemistry and Industry, vol. 48, September 13, 1929, p. 725.

"Molten pig iron containing molybdenum is tapped directly from the blast furnace into a charge of molten iron or steel in any type of steel furnace. Alternatively, the pig iron containing molybdenum may be melted together with the usual charge in a cupola to produce cast iron containing molybdenum."

Coulter, Wm. J. Mining molybdenum ore. Eng. and Min. Jour., vol. 127, March 9, 1929, pp. 394–400.

——— Crushing and concentrating molybdenum ore at Climax, Colo. Eng. and Min. Jour., vol. 127, March 23, 1929, pp. 476–480.

Fujiwara, Takeo. Tensile strength and fracture of rolled strips of molybdenum. Mem. Coll. Sci. Kyoto Imp. Univ. A 12, 1929, pp. 165–78. Chem. Abs., vol. 23, October 10, 1929, p. 4659.

"The tensile strengths of rolled strips of Mo, especially in reference to the direction of rolling, were determined with a tensile testing machine, and their fractures examined by means of photomicrographs and X rays."

Hertel, W. Experiments on the working of galena-wulfenite concentrates. Metall u. Erz, vol. 26, 1929, pp. 115–118. Chem. Abs., vol. 23, August 10, 1929, p. 3645.

"Wet and dry methods given in the literature for working the pure Mo ore prove unsatisfactory when used on the galena-wulfenite concentrate. By passing gaseous HCl over the finely divided ore, the Pb and Mo therein may successfully be separated. Experiment shows that at 390°, heating for 1.75–2.0 hours, all the Mo above 0.4 per cent is sublimed off. Under these conditions practically all of the Pb is converted into $PbCl_2$."

Johnson, J. Y. Manufacture of complex tungsten and molybdenum compounds (and pigments, color lakes, etc., containing them). British Patent 312975, March 3, 1928. Chem. and Ind. (London), vol. 48, August 16, 1929, pp. 643–44.

Kissock, A. (to Climax Molybdenum Co.). Molybdenum-bearing pig iron. British Patent 300570, November 15, 1927. Chem. Abs., vol. 23, August 20, 1929, p. 3893.

"A Mo-bearing pig iron (which may be made by the process described in British Patent 299800) may be used as an alloying agent in a solid or molten state for admixture with iron or steel or as part of the charge in a steel-making furnace for the production of gray, white, malleable or semisteel castings."

——— Iron alloys containing molybdenum. British Patent 293860, July 15, 1927. Chem. Abs., vol. 23, April 10, 1929, p. 1611.

"Mo is added to Fe or other metals or their alloys by adding a Mo compound such as Ca molybdate to a molten bath or slag on such a bath of which at least one constituent has a greater affinity for O than Mo has. The addition may be made during reduction or melting of the iron. Alloys of Mo with Ni, Al, Cu, and Si are mentioned."

Meerson, G. A. Production of tungsten and molybdenum. Zhur. Prikladnoi Khim. (Moscow), vol. 2, 1929, pp. 133–48. Chem. Abs., vol. 23, August 20, 1929, p. 3884.

Naamlooze Vennootschap Philips' Gleoilampenfabrieken. Soldering tungsten and molybdenum. British Patent 289553, January 31, 1927. Chem. Abs., vol. 23, February 10, 1929, p. 595.

Palmer, L. A. Vanadium and molybdenum compounds in clays. Jour. Am. Ceram. Soc., vol. 12, 1929, pp. 37–47. Chem. Abs., vol. 23, March 20, 1929, p. 1485.

"Eight light-burning clays and shales containing small quantities of insoluble V and Mo compounds were studied. During slow firing, soluble salts of these elements were formed which later appeared as a yellow-green efflorescence on the fired clay. The color was due chiefly to alkali vanadates. The use of either Na_2SiF_6 or CaF_2 was effective in eliminating the efflorescence."

Rock, Max E. Alloys. German Patent 474887, July 17, 1927. Chem. Abs., vol. 23, June 20, 1929, p. 2926.

"Alloys for dental work contain Cr 23–40, Ni 13–24, Cu 6.5–13, Au about 33.4, Ag 3.5, and Mo 3.5 per cent."

Smidt, H. H. Molybdenum. Tids. Kemi og Bergvesen, vol. 8, 1928, pp. 66–9. Chem. Abs., vol. 23, August 20, 1929, p. 3884.

"A statistical, metallurgical, chemical survey."

Wurth, Carl F. The influence of molybdenum and silicon on the properties of a non-corrodible steel. Diss. Tech. Hochschule Aachen 1927, 14 pp. Chem. Abs., vol. 23, November 10, 1929, p. 5142.

"Increasing quantities of Mo, Si, and C have been added to a 15 per cent Cr-steel. The resulting properties have then been investigated. Three-tenths per cent Mo gives maximum hardness. More than 0.3 per cent C is not advisable because the hardness increases only very little, while the resistance to corrosion is badly affected. Neither the A_1 nor the A_3 transformation point can be detected in soft steels containing more than 3 per cent Si. All the steels with more than 3 per cent Si are brittle. Mo-Cr steels are not corroded in AcOH or in sea water. $HgCl_2$ is a good detector of pores and flaws. All steels with high Si content resist scaling at high temperature remarkably well. The same holds for Si-Mo steels. The resistance to scaling increases with the C content."

Yamada, Gaichi. Ore dressing of molybdenum ore. Monthly Jour. Min. and Met., vol. 6, 1928, pp. 205–22. Chem. Abs., vol. 23, April 10, 1929, p. 1598.

"The raw molybdenite ore contains about 1 per cent of MoS_2, but the product required in the market as refined ore is of about 85 per cent grade, so that the ore dressing is very important with molybdenite. To meet this demand and also for greater efficiency, froth flotation is exclusively preferred. Molybdenite can be readily treated by flotation and is well fitted for dressing, but the raw ore is accompanied in many cases by pyrite, which considerably lowers the quality of the product of flotation. The dressing method is the same as methods generally applied; i. e., large grains are dressed by hand, while the finer, scaly ones are crushed. To obtain a high-grade ore, a comparatively large grain is necessary, but when too large, there is a danger of its escaping flotation and going away into the tailing; so the grains are usually ground to below 35-mesh fineness. Pine oil is used for frothing, and kerosene for collecting; the quantities vary according to the nature of the ore and the degree of grinding. The usual quantities are: Pine oil, 0.25 lb./ton, kerosene, 0.5–0.7 lb./ton. According to Y's experiment a mixture containing 8 parts of camphor oil and 2 parts of coal tar gave a much better result. Too much oil lowers the quality of the refined ore. Such reagents as lime or soda improve the quality of the refined ore, but make use of a larger quantity of oil necessary. When pyrite or other soluble salts are present, better results are obtained by using alkaline reagent. Some of the pyrite found in the refined ore can be removed by sieving."

Zschocke, Karl W. Filaments manufactured from tungsten, molybdenum, and other difficultly fusible metals at a temperature below 1,000°. Austrian Patent 113453, January 15, 1929. Chem. Abs., vol. 23, September 10, 1929, p. 4153.

"Mechanical and manipulative features are given."

TANTALUM

DOMESTIC PRODUCTION

During 1929, as in previous years, columbite was produced in the United States only in the Black Hills of South Dakota, where it was mined by the Black Hills Tin Co., at Tinton; by Collingwood & Greene, near Pringle; and by A. T. Roos, near Rapid City. Shipments during the year amounted to 22,117 pounds, valued at $17,261.

The production of tantalum minerals in the United States (all from South Dakota) during the past 10 years is shown in the following table.

Columbite, mined in the United States, shipped in 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	4,000	$1,450	1925		
1921	3,400	1,150	1926	2,100	$650
1922	600	240	1927	1,100	378
1923	1,350	540	1928	34,899	26,332
1924	1,197	598	1929	22,117	17,261

USES

Tantalum has been found to be adapted to many uses, particularly in chemical laboratory equipment, spinnerets for artificial silk, jewelry, and radio tubes, and during 1929 its commercial development progressed steadily. The uses of tantalum, its properties, occurrence, markets, etc., are discussed in some detail in Bureau of Mines Information Circular No. 6328, entitled "Tantalum (and Columbium)." The practicability of tantalum for laboratory use has been demonstrated at the bureau's experiment station at Berkeley, Calif., and the results attained have been described by C. G. Maier,[4] as follows:

> In the course of its program of study of the fundamental properties of metallurgically important materials, the bureau's Pacific Experiment Station more than a year ago constructed a new type of precision calorimeter for studying the dissolution of metals and oxides in strong acids. A part of the calorimeter is a cylindrical can with hemispherical bottom and flanged top, which must withstand the action of strong mineral acids for long periods of time. In one series of experiments it was necessary to subject material to the action of 2.5 normal hydrochloric acid; in other experiments acidulated copper solutions of a very corrosive nature were used.
>
> A tantalum and bakelite construction, which has been in constant use for more than a year, has proved not only ideal from the corrosion point of view, but also decidedly economical. For materials of construction of this sort, experimenters in the past have been accustomed to use platinum or gold. The container made of platinum would have cost $1,500, of gold $300, for metal alone, but of tantalum cost actually only $150 completely fabricated. In the case of gold, because fine gold would have to be used, difficult reinforcing problems would have been encountered. Neither platinum nor gold would have had the mechanical strength of the tantalum. The mechanical usage has been severe, since the contents of the container are constantly stirred, and at one step of the experiments, glass containers are smashed directly upon the hemispherical bottom. The seams of the apparatus, which is made of 10 mil sheet, were roller welded, and have not given the slightest trouble; nor has there been any trace of corrosion in this period.
>
> The economy of tantalum for the solution of laboratory problems of the type described is probably not as widely nor generally recognized as the usefulness of the material justifies. Even if the price were as great as gold, the great mechanical strength and toughness of the tantalum would justify its use.

TECHNOLOGY

During the year a new method of separation of columbium from tantalum was developed at the Rare and Precious Metals Experiment Station of the Bureau of Mines at Reno, Nev. It possesses an advantage both in time and expense over the older methods of obtaining columbium free from tantalum.

The Bureau of Standards published the results of tests on the thermal expansion of tantalum, in which it was found that worked tantalum expands practically the same as annealed tantalum. The coefficient of expansion of tantalum increases slightly with temperature. From 20° to 100° C. the average coefficient of expansion is 6.6 times 10^{-6} per degree centigrade.

The first metallic columbium made in the United States was exhibited in New York in the autumn of 1929 by Dr. C. W. Balke, chemical director of the Fansteel Products Co., of North Chicago, Ill.

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[4] Maier, C. G., Tantalum Proves Economical for Calorimeter Body: Chem. and Met. Eng., vol. 36, September, 1929, p. 553.

IMPORTS

Imports since 1920 are shown in the following table:

Tantalum ores imported into the United States, 1920–1929

Year	Pounds	Value
1920	[1] 60	$54
1921	[1] 1,229	788
	[2] 6,785	1,327
1922	----------	----------
1923	[3] 5,600	3,031
1924	----------	----------
1925	[3] 5,022	$1,347
1926	[3] 350	149
1927	[3] 15,119	20,012
1928	----------	----------
1929	[3] 15,250	19,418

[1] Classified as "Ferro-alloys (tantalum)."
[2] Classified as "Steel-hardening ores (tantalum)."
[3] Classified as "Ores of ferro-alloying metals (tantalum)."

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The following articles on tantalum, to which is appended a list of recent patents, are among those that appeared or became available during 1929:

BALKE, CLARENCE W. Metals of the tungsten and tantalum groups. Ind. and Eng. Chem., vol. 21, November, 1929, pp. 1002–7.

DYSON, G. MALCOLM. The production and uses of tantalum. Chem. Age (London), vol. 20, March 2, 1929, pp. 18–19.

HEINRICH, FR., and PETZOLD, F. Tantalum as a material for making chemical apparatus. Chem. Fabrik, 1928, pp. 689–91. Chem. Abs., vol. 23, March 10, 1929, p. 1015.

"A compilation of data on the physical and chemical properties of Ta, supplemented by the authors' experiments, indicates that although it may serve well for the manufacture of chemical apparatus because of its great resistance to the attack of acids, yet limitations as to the temperature at which it may be used, especially in the presence of various gases, may prevent it from becoming wholly acceptable for this purpose."

HIDNERT, PETER. Thermal expansion of tantalum. United States Bureau of Standards Research Paper 62. Reprinted from United States Bureau of Standards Jour. of Research, vol. 2, May, 1929.

"Gives data on the linear thermal expansion of three samples of worked and annealed tantalum over various temperature ranges between −190 and +500° C. A summary of available data by previous observers on the thermal expansion of tantalum is included."

HUNTER, F. L. Tantalum in vacuum tubes. Radio Engineering, vol. 9, December, 1929, pp. 29–31.

"A discussion of the uses and advantages of tantalum in the manufacture of vacuum tubes."

JONES, CHESTER H. Tantalum—A metal for difficult corrosion problems. Chem. and Met. Eng., vol. 36, September, 1929, p. 551.

NAG, N. C. Chemical and electroscopic examination of a sample of radioactive columbite from Gaya district. Trans. Geol. Min. and Met. Soc. India, vol. 2, 1929, pp. 1–6.

SCHOELLER, W. R., and WATERHOUSE, E. F. Investigations into the analytical chemistry of tantalum, columbium and their mineral associates. XIII. New method for the separation of zirconium and hafnium from tantalum and columbium. Analyst, vol. 53, 1928, pp. 515–20.

SEARS, GEORGE W. Critical studies of the fusion of rare metal ores. III. Determination of tantalum and columbium. Jour. Am. Chem. Soc., vol. 51, January, 1929, pp. 122–29.

SPITZIN, VICTOR I., and KASHTANOV, L. Chemistry of tantalum. Z. anorg. allgem. Chem., vol. 182, 1929, pp. 207–27. Chem. Abs., vol. 23, November 20, 1929, p. 5425.

STROCK, LESTER W., and LUKENS, HIRAM S. The use of tantalum as cathode for the electrodeposition of copper. Trans. Am. Electrochem. Soc., vol. 56 (preprint), 1929, 9 pp.

"Details of procedure are given."

YNTEMA, L. F. The separation of columbium and tantalum by electrolytic hydrolysis. Trans. Am. Electrochem. Soc., vol. 55 (preprint), 1929, 3 pp. Chem. Abs., vol. 23, July 10, 1929, p. 3179.

"An incomplete separation of Cb and Ta is effected by making the solution of the mixed salts the electrolyte in the anode compartment of an electrolytic cell. The separation depends on the precipitation of the insoluble columbic and tantalic acids at the different H-ion concentrations produced during the course of the electrolysis."

PATENTS

ARMSTRONG, PERCY A. E. Iron alloy. U. S. Patent 1687486, October 16, 1928. Chem. Abs., vol. 23, January 10, 1929, p. 88.

"An alloy resistant to scaling at elevated temperatures contains Cr 9, C 0.50, Si 3.5 and Ta 3 per cent; the remainder is principally Fe. This alloy is suitable for valves of internal-combustion engines."

——— Ferrous alloys containing chromium and tantalum. U. S. Patent 1711484, May 7, 1929. Chem. Abs., vol. 23, July 10, 1929, p. 3204.

"A rust, heat, and acid resisting alloy suitable for cutlery, valves, etc., comprises Fe together with Cr 7–25, Ta about 0.2–3.0 per cent and C about 1.25 per cent or less. Mn and Si also may be added in small proportions."

AUSTIN, MINER M., and BALKE, CLARENCE W. (to Fansteel Products Co.). Apparatus for removing carbon and gases from tantalum wire. U. S. Patent 1688481, October 23, 1928. Chem. Abs., vol. 23, January 10, 1929, p. 89.

ENGLE, EDGAR W., and AUSTIN, MINER M. (to Fansteel Products Co.). Tantalum-alloy pen. U. S. Patent 1701299, February 5, 1929. Chem. Abs., vol. 23, March 20, 1929, p. 1383.

"Pens are made with nibs of Ta 90 and W 10 per cent."

MARDEN, JOHN W., and RICH, MALCOLM N. (to Westinghouse Lamp Co.). Rare metals. U. S. Patent 1728941, September 24, 1929. Chem. Abs., vol. 23, November 10, 1929, p. 5150.

"In order to obtain Ta, V and Cb powder free from H and N, the oxide is heated with Ca and $CaCl_2$ in a sealed or evacuated container in the presence of an alkali metal."

REMY-STAHLWERKE STAHL SCHMIDT & CO. GES. Alloy steel for "high-speed" tools. British Patent 289990, February 28, 1927. Chem. Abs., vol. 23, February 20, 1929, p. 813.

"An alloy steel is specified containing W 17, Cr 5, V 1.5, Ta 7, and C 0.9 per cent, with or without Mo 2 per cent."

STAHLWERKE ROCHLING BRUDERUS A.- G. and KROPF, ALFRED. Refractory material. German Patent 469433, December 19, 1926. Chem. Abs., vol. 23, April 10, 1929, p. 1732.

"Ta powder, which may contain up to 10 per cent of impurity is mixed with graphite in the proportions 3:2 with the use of a binder; e. g., pitch or molasses. The mixture is molded under pressure, dried at 300–500°, and then heated at 2,000–3,000°. The molded piece may be given a coating of graphite before heating. The products may be used as electrical-resistance heaters or for making crucibles, furnace linings, etc."

TITANIUM

DOMESTIC PRODUCTION

During 1929 the American Rutile Co. (a subsidiary of the Metal & Thermit Corporation) shipped ilmenite and rutile from stock at its mine at Roseland, Nelson County, Va. The production of titanium minerals during the last 10 years, so far as data are available to the Bureau of Mines for publication, is shown in the following table; the quantities are largely for shipments rather than direct production.

Titanium minerals produced in the United States, 1920–1929

Year	Rutile concentrates			Ilmenite concentrates		
	Short tons	Percentage of TiO_2	Value	Short tons	Percentage of TiO_2	Value
1920	277	94–96	(1)	268	50	(1)
1921	------	------	------	------	------	------
1922	310	95	(1)	5,181	52–54	(1)
1923	270	95	(1)	6,270	52	(1)
1924	------	------	------	4,769	52	[2] $76,300
1925	46	95	[2] $11,000	5,566	52	[2] 89,000
1926 [3]	30	95	[2] 7,500	4,813	52	[2] 77,000
1927	524	95	129,861	3,500	50	44,000
1928	(1)	(1)	(1)	(1)	(1)	(1)
1929	(1)	(1)	(1)	(1)	(1)	(1)

[1] Bureau of Mines not at liberty to publish figures.
[2] Arbitrary value.
[3] Figures for Florida only. Bureau of Mines not at liberty to publish figures for Virginia.

During 1928 the Vanadium Corporation of America acquired ilmenite properties on the border of Nelson and Amherst Counties, Va., and did considerable drilling during 1929. At the end of the year its subsidiary, the Southern Mineral Products Corporation, awarded a contract for designing and constructing a mining, milling, and chemical plant at its Virginia properties. The Vanadium Corporation has been engaged in developing a concentrating process for separating the ilmenite from the gangue, and according to common report is contemplating adding titanium pigments to its list of products. The Titanium Pigments Co. also did some drilling on its properties in the vicinity of Roseland, Va. A shaft has been sunk in the ilmenite deposit at Fort Edwards, N. Y. The Buckman & Pritchard operation near Jacksonville Beach, Fla., was discontinued. Some further work was done on the beach deposits in California, but the Bureau of Mines has no record of shipments being made.

GENERAL CONDITIONS

Domestic sales of titanium pigments were said to have been one-third larger in 1929 than in 1928. Titanium white is marketed in the form of the nearly pure oxide and also blended with blanc fixe and zinc oxide. A new product, titanated lithopone, was also marketed in 1929. The desirable properties of titanium pigments have been summarized by Hixson and Plechner,[5] as follows:

> Paints made with titanium pigments have shown no tendency to crack or peel, but have worn down evenly and uniformly, the surface finally becoming powdery ("chalking") and remaining in excellent condition for repainting. Since a pure titanium oxide paint is inclined to be too elastic the addition of zinc oxide as a hardener gives an even more durable paint. Owing to the fact that titanium oxide is a neutral pigment it has no action whatsoever on the vehicle, making a very slow-drying "tacky" paint. This condition is overcome by the addition of zinc oxide or driers. Since titanium oxide, like the similar oxide of silicon, is the most stable compound of the metal, the pigment is extremely resistant to attack by any of the destructive agencies to which it is likely to be exposed. That it will resist the attack of sulphuric acid, which is notoriously the chief destructive agent in the air of cities, that it is not fully oxidized and therefore is not attacked by sea air or salt water, make it an excellent pigment.

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[5] Hixson, A. W., and Plechner, W. W., Titanium Offers New Possibilities as a Pigment: Chem. and Met. Eng., vol. 36, February, 1929, pp. 76–78.

Titanium pigments are manufactured in the United States by the Titanium Pigments Co., a subsidiary of the National Lead Co., with plants at St. Louis and Niagara Falls, and by the Commercial Pigments Co., a subsidiary of the Commercial Solvents Corporation, with a plant at Baltimore. These pigments are usually made from ilmenite. Ilmenite is also used in the manufacture of ferrocarbontitanium, produced by the Titanium Alloys Manufacturing Co., and carbide-free ferrotitanium, produced by the Metal & Thermit Corporation. Rutile is used chiefly in the ceramic industry, especially in tile and in dinner ware, to add color and strength.

The United States probably consumes more titanium pigments than all the rest of the world; Europe, however, uses a larger proportion as compared to the total amount of all kinds of pigments consumed, due in part to restrictive legislation affecting the use of white lead in paints. European sales are reported to have doubled in 1929. The plant of the Titan A./S. company at Fredrikstad, Norway, the first to produce titanium pigments, has been closed, but a new plant has been completed by the same interests at Leberkussen-am-Rhein, near Cologne. The Titan concern (now affiliated with the National Lead Co.) is the largest European producer, but there is another plant in Germany, a factory in England, and one in Italy. Canada has at present no titanium industry, but a Canadian company, Titanium (Ltd.), has secured control of the Ivry ilmenite deposits for the purpose of utilizing material from them in the manufacture of titanium white; however, no plant has been erected yet.

Partly as a result of a reduction in the price (from 10 cents to 8 cents a pound in the case of the 15 per cent ferrocarbontitanium alloy), sales of titanium ferro-alloys increased in 1929.

IMPORTS

Ilmenite sand is imported extensively from Travancore, India, and from Senegal. From time to time shipments have also been made from Brazil. The imports of ilmenite as recorded by the Bureau of Foreign and Domestic Commerce amounted to 25,072 short tons, valued at $104,887, in 1929, as compared with 17,224 tons, valued at $79,640, in 1928. A study of the customhouse records indicates that in 1928 there was also imported 5,000 tons of material, having a value of around $4 a ton, from these ilmenite-producing countries and entered by the importer and hence classified in the import statistics as "sand, other than glass sand." Much of the ilmenite imported is from beach deposits in which it occurs associated with monazite and zircon, and in former years undoubtedly much ilmenite was included in the statistics for sand and other items which like ilmenite are exempt from duty. A study of the records for 1929, however, indicates that this situation is much improved, although even now some of the ilmenite imported probably escapes being recorded under its special category. In Quebec, for example, deposits of massive ilmenite are worked at Ivry and at Baie St. Paul and the ore which contains up to 38 per cent TiO_2 is shipped to the United States, but this movement does not appear in the import statistics.

Rutile is imported from Norway, but only in small amounts. This mineral is also associated with the ilmenite produced at St. Urbain, near Baie St. Paul, in Quebec, and shipped to the General Electric Co.'s works at West Lynn, Mass.

WORLD PRODUCTION

The world production of titanium minerals in 1928 and 1929, as gathered from Government reports and other available sources, is shown in the following table:

World production of titanium minerals, 1928 and 1929

Mineral and country	1928			1929		
	Ore produced	Content of TiO_2	Value [1]	Ore produced	Content of TiO_2	Value [1]
Ilmenite:	*Metric tons*	*Per cent*		*Metric tons*	*Per cent*	
Brazil [2]	1,498	(3)	(3)	6,361	(3)	$75,109
Canada (Quebec)	2,036	(3)	$6,726	2,493	(3)	7,304
India (Travancore)	25,713	(3)	202,226	(3)	(3)	(3)
Norway	7,948	42.6	61,915	(3)	(3)	(3)
Portugal	703	(3)	3,140	(3)	(3)	(3)
Senegal	2,110	[4] 50	6,623	[2] 7,240	(3)	24,280
United States	(5)	(5)	(5)	(5)	(5)	(5)
Rutile:						
Norway	[6] 59	90–93	18,414	(3)	(3)	(3)
United States	(5)	(5)	(5)	(5)	(5)	(5)

[1] Values as officially reported, converted to United States currency at the annual average rate of exchange as published by the Federal Reserve Board.

[2] Exports.

[3] Data not available.

[4] Estimated.

[5] Bureau of Mines not at liberty to publish figures.

[6] Concentrates.

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American Society for Testing Materials. Tentative standards 1928. Separate, 1928, 932 pp. Chem. Abs., vol. 23, March 20, 1929, p. 1450.

"Tentative revisions of A.S.T.M. Standards are proposed for routine analysis of Ti pigments."

Blackwood, P. W. The metallurgical aspects of cast iron. Trans. Am. Soc. Steel Treating, vol. 13, 1928, pp. 1023–1038. Chem. Abs., vol. 23, January 10, 1929, p. 72.

"A discussion of the effect of additions of Ni, Cr, W, Mo, V, Ti, Cu, and Al."

Blumenfeld, Joseph (to Commercial Pigments Corporation). Titanium oxide. U. S. Patent 1707248, April 2, 1929. Chem. Abs., vol. 23, May 20, 1929, p. 2538.

"Preliminary to Ti oxide manufacture $FeSO_4$ is removed from a solution containing Ti, ferrous Fe, and H_2SO_4 by cooling the solution to about 5° or lower and separating the $FeSO_4$ crystals which form."

——— Preparation of titanium and like compounds (oxides and hydroxides). British Patent 275672, August 9, 1927. Chemistry and Industry (London), vol. 48, March 15, 1929, p. 207.

"Solutions obtained by the decomposition of ilmenite, etc., with sulphuric acid containing, e. g., 200 g. TiO_2 and 500 g. H_2SO_4 (free and combined) per liter, are introduced at 100–110° into about one-quarter of their volume of boiling water at a uniform rate during about 10 minutes, the mixture being well stirred during the addition and then boiled for 2–3 hours, to precipitate colloidal titanium hydroxide. The product may be dispersed as described in British Patent 247296. Compounds of the rare-earth metals may be similarly prepared."

British Engineering Standard Association. British specification for white titanium dioxide pigment for paints. No. 392, 1929, 7 pp. Chem. Abs., vol. 23, July 20, 1929, p. 3585.

BROWN, GEORGE H. Notes on production of cream-colored bodies. Ceram. Age, vol. 11, 1928, pp. 77–79. Chem. Abs., vol. 23, January 10, 1929, p. 253.

"Several series of clay mixtures of rutile and TiO_2 with clays containing various iron contents were prepared and burned. With low Fe_2O_3 contents a light cream color was obtained, but with increasing Fe_2O_3 the color ranged from tan to greenish gray. Conclusion: (1) Rutile is satisfactory for use in the development of cream-colored vitreous floor-tile bodies. (2) Better colors are secured in bodies which are free from ball clay and low in Fe_2O_3, as the color secured from TiO_2 or rutile is largely dependent upon the proportions of rutile and Fe_2O_3. (3) The use of TiO_2 as a coloring agent in place of rutile has great possibilities, and satisfactory colors can be secured in vitreous bodies using ball clay if TiO_2 is utilized instead of rutile. TiO_2 is very hard to grind, has a tendency to crystallize on a clay body, and has an uncertain effect on the body. Rutile gives variable color effects owing entirely to variations and irregularities in the burning."

DEUTSCHE GASGLUHLICHT-AUER-GES. Treating titanium ores. British Patent 309597, June 6, 1929. Jour. Am. Ceram. Soc., vol. 8, September, 1929, p. 691.

"In the treatment of titanium ores containing chromium with sulphuric acid with recovery of the latter for reuse, the chromium is removed from the recovered acid by concentration thereof to at least 92 per cent strength, followed by prolonged heating at or above 300° C."

DITMAR, RUDOLPH. Titanium dioxide in the rubber industry. Kautschuk, vol 5, 1929, pp. 79–81. Chem. Abs., vol. 23, July 10, 1929, p. 3371.

"The characteristics and behavior of TiO_2 as a rubber compounding ingredient are described. Among the properties which may be of importance are its ability to soften rubber notably during milling and the limitations in the choice of accelerator to obtain a strictly white vulcanizate when it is used as the only white pigment."

FARBENIND, I. G. Manufacture of titanium compounds. British Patent 290174, May 7, 1928. Chem. and Ind., vol. 48, October 25, 1929, p. 851.

"The mixture obtained by treating ilmenite, etc., with sulphuric acid is treated hot with sufficient quantities of an alkali salt (preferably potassium sulphate) and water to yield a saturated potassium titanium sulphate solution, which is filtered and then cooled to crystallize out the double sulphate; the crystals are removed, purified by washing with alkali sulphate solution or by crystallization from dilute sulphuric acid, and worked up to give the desired titanium compounds."

GENIN, G. Titanium pigments. Peintures, pigments, vernis, vol. 5, 1928, pp 631–7. Chem. Abs., vol. 23, August 20, 1929, p. 4087.

"A discussion of the history and occurrence of titaniferous materials usable as pigments and of the methods of preparing Ti pigments. Methods of analysis are outlined."

HEATON, NOEL. The development of titanium oxide pigments. Chem. Age (London), vol. 21, November 9, 1929, p. 423.

HIXSON, A. W., and PLECHNER, W. W. Titanium offers new possibilities as a pigment. Chem. and Met. Eng., vol. 36, 1929, pp. 76–8. Chem. Abs., vol. 23, April 10, 1929, p. 1761.

"Ti pigments are reviewed and their characteristics compared with other paint pigments. Tables are given to show that while Ti pigments are higher priced per pound they are relatively cheap per square foot of painted surface because of their high tinting strength and obscuring power."

HURST, J. E. Vanadium and titanium in cast iron. Foundry Trade Jour. vol. 41, 1929, pp. 173–4, 176. Chem. Abs., vol. 23, November 20, 1929, p. 5456.

"Previous investigations studying the influence of small additions of V and Ti to cast Fe are reviewed and valuable possibilities are discussed in the commercial development of cast Fe containing V and Ti."

JACK, R. LOCKHART. Pigment minerals of South Australia. Bull. Geol. Survey S. Australia, No. 13, 1928, 70 pp. Chem. Abs., vol. 23, November 20, 1929, p. 5446.

"Barite, talc, ocher, ilmenite, clay, gypsum, Cu carbonates, graphite, and MnO_2 are mined for pigments. Several chemical analyses of raw materials are given. Light yellow carphosiderite (analysis given) is available in large amounts. This mineral is roasted for the preparation of red oxide."

Millot, Marius. Apparatus for washing titaniferous sand. French Patent 651838, March 28, 1928. Chem. Abs., vol. 23, July 20, 1929, p. 3432.

Monk, Reginald H. Titanium oxide. U. S. Patent 1695341, December 18, 1929. Chem. Abs., vol. 23, February 20, 1929, p. 939.

"Refractory Ti compounds such as those from rutile or ilmenite after elimination of other impurities and a large portion of the Fe content are converted into water-soluble sulphates by mixing with alkali metal sulphate and an acid solvent such as H_2SO_4, heating the mixture at 120–300° until a solid cake is formed, cooling and crushing the cake."

National Metal & Chemical Bank, Ltd. Treatment for titaniferous ores. German Patent 478136, May 18, 1926. Chem. Abs., vol. 23, September 10, 1929, p. 4181.

"The powdered ore with its natural moisture content or after addition of moisture is treated with oleum and the reaction is allowed to proceed without the application of heat. TiO_2 may be obtained from the product by dilution with water."

Osborne, F. F. Certain magmatic titaniferous iron ores and their origin. Econ. Geol., vol. 23, 1928, pp. 724–761, 895–922.

Soc. Minière "La Barytine" and Raffin, Maurice. Paint. French Patent 655085, October 14, 1927. Chem. Abs., vol. 23, August. 20, 1929, p. 4088.

"Ti white is prepared from Fe-Ti ores, by heating the ores with Na_2CO_3 and coal to reduce the Fe to the metal, which is removed by treatment with dilute H_2SO_4. The Ti is converted to the sulphate by treatment with stronger acid and to TiO_2 by addition of BaO."

Stephens, F. G. C., Anderson, L. J., and Cash, W. A. Titanium pigments. British Patent 299835, August 2, 1927. Chem. Abs., vol. 23, July 20, 1929, p. 3587.

"A Ti sulphate solution is added gradually to a prepared bulk of a solution of a soluble alkali earth metal salt such as $BaCl_2$, and a temperature of 30–35° is suitable during the precipitation of the alkali earth metal sulphate, with a subsequent heating at about 100° to precipitate substantially all the Ti from the solution. Various details are given."

Times Trade and Engineering Supplement (London). Titanium salts and pigments. Principal outlets. Vol. 23, 1928, p. 33. Chem. Abs., vol. 23, March 20, 1929, p. 1476.

"A review of the main processes. Much interest is now being shown in the Monk-Irwin process involving hitherto unused Canadian ores."

Titanium Pigment Co. Recovery of titanium compounds. British Patent 288569, March 15, 1928. Chem. and Ind. (London), vol. 48, August 2, 1929, p. 597.

"Finely ground ilmenite is mixed with 72–92 per cent sulphuric acid and steam is injected into the lower part of the reaction vessel until the temperature reaches 120° and the mass thickens; a small quantity of water is then forced into the lower part of this thick pulp, followed by vigorous streams of air to keep the mass in agitation and to render it porous, and finally the cooled solid mass is treated with just sufficient water to dissolve the iron and titanium sulphates. The clear solution is agitated with scrap iron or zinc to reduce ferric to ferrous sulphates, and the titanium is recovered by hydrolysis in the usual way."

Traill, R. J., and McClelland, W. R. Process for the treatment of ilmenite for the recovery of electrolytic iron and titanium oxide concentrate for pigment and other purposes. Canada Dept. Mines, Mines Branch No. 688, 1928, pp. 96–101. Chem. Abs., vol. 23, January 20, 1929, p. 341.

"In this preliminary study the results indicate the practicability of operating a plate cell at about 35 amp. per square foot, without causing undue Cl evolution at the anode, by arranging a rapid flow of electrolyte through the catholytic compartment of the cell."

Ulrich, Frantšek. Occurrence of rutile in the siderite veins of Rožnava, Slovakia and its position in the vein paragenesis. Rozpravy České Akad., Cl. 2, vol. 37, 1928, 15 pp. Chem. Abs., vol. 23, May 20, 1929, p. 5441.

"Rutile is found with albite in a vein cavity. The wall rock is an aplite composed of albite, quartz, tourmaline, apatite, rutile, and siderite. The aplitic intrusions are younger than the siderite veins and are closely associated with sulphide ores."

Van Hoek, C. P. Titanium dioxide and titanium white. Farben-Ztg., vol. 34, 1929, pp. 2828–32. Chem. Abs., vol. 23, November 20, 1929, p. 5598.

"The usefulness of Ti pigments in exterior paints is questioned because of the excessive chalking. TiO_2 itself should be used only in limited quantities as an ingredient of paints. 135 references are given."

Verein für chemische und metallurgische produktion. Titanium paints and pigments. British Patent 302659, December 19, 1927. Chem. Abs., vol. 23, September 10, 1929, p. 4356.

"Ti paints and pigments comprise TiO_2 separated from H_2SO_4 solutions and dehydrated by heat, and preferably 10–30 per cent $BaCO_3$, with or without diluting substances."

Villa, A. Titanium oxide pigments. Tech. moderne, vol. 21, 1929, pp. 397–402. Chem. Abs., vol. 23, September 10, 1929, p. 4354.

"A review of the history, sources, and manufacture of these products."

——— White titanium oxide pigments. Tech. moderne, vol. 21, 1929, pp. 434–9. Chem. Abs., vol. 23, November 10, 1929, p. 5335.

"The properties of these pigments are compared with other white pigments."

Wassman, S. Problemas metalurgicas sobre el tratamiento de la arena ferruginosa de la costa atlantica de Buenos Aires. (Metallurgical problems in the treatment of the ferruginous sands of the Atlantic Coast of Buenos Aires.) Argentina Dirección Gen. de Minas, Geol. é Hidrol., Pub. 64, Buenos Aires, 1929, 7 pp.

Whittemore, Carl Raymond. Titanium oxide from titaniferous iron ores. Canadian Patent 1699173, January 15, 1929. Eng. and Min. Jour., vol. 127, February 23, 1929, p. 329.

"This process of preparing titanium oxide from titaniferous iron ore comprises reducing the iron content to sponge iron without fusion or sintering, cooling in a nonoxidizing atmosphere, and separating the sponge and titanium content from the nonmagnetic portion. The treated ore is then dissolved with a solvent, and the residue heated with an acid to 250° C. in a digester to form titanium salts. After having been disintegrated, the mass is lixiviated with cold water, and the solution hydrolyzed to precipitate titanium hydroxide. The precipitate is then calcined."

Wurm, Erich. Titanium white or lithopone? Gummi-Ztg., vol. 43, 1929, p. 2752. Chem. Abs., vol. 23, November 10, 1929, p. 5351.

"Experiments during the past 3 years by W. do not support the contention that TiO_2 is more economical than lithopone in rubber. Based on the relative costs and coloring power lithopone is the more economical, and furthermore vulcanizates containing lithopone age considerably better than the corresponding vulcanizates containing TiO_2, particularly with products cured with S_2Cl_2. Examination of TiO_2 from different sources shows that all contained traces of Ti. It is considered that lithopone is much preferable to TiO_2 as a white pigment for rubber goods."

TUNGSTEN

UNITED STATES

Contrary to general expectations, the sales of tungsten produced in the United States dropped in 1929 to only 830 short tons of concentrates carrying 60 per cent of tungsten trioxide (WO_3). In 1928 sales were 1,208 tons. However, due to the rise in price of tungsten ores, the decrease in value was relatively small—from $753,900 in 1928 to $654,000 in 1929. Tungsten ore from domestic mines was produced and sold in 1929 by 14 companies.

The tungsten production of the United States during the last 10 years has been as follows:

Concentrated tungsten ores (reduced to equivalent of 60 per cent WO_3) produced in the United States, sold in 1920–1929, and average price per unit

Year	Short tons	Value	Average price per unit	Year	Short tons	Value	Average price per unit
1920	216	$101,800	$7.86	1925	1,191	$755,500	$10.57
1921				1926	1,382	920,400	11.10
1922				1927	1,164	724,000	10.37
1923	241	144,600	[1] 10.00	1928	1,208	753,900	10.40
1924	[2] 565	[2] 287,000	8.47	1929	830	654,000	13.13

[1] The output of 1923 was made by one company only, which sold to its owners at a price considerably above the market.

[2] Includes 191 tons produced in 1919, sold in 1924 for $87,000.

Arizona.—The Tungsten Production Co. (Inc.), of Boulder, Colo., continued prospecting for scheelite in Cochise County. The mill of Edward C. O'Brien & Co. was in operation. Construction of a mill was started by Frank Samsel. Early in the year the Stoody Co., of Whittier, Calif., acquired the Yucca tungsten mine in the Cedar Valley mining district, approximately 18 miles east and north of the town of Yucca; only development work was done during the year.

California.—The Atolia Mining Co. continued to work the low-grade residual placer deposits and the dumps from its mine at Atolia. The Tungsten Corporation of America purchased the Round Valley mine, near Bishop, Calif., and five tungsten claims in the Atolia district of Kern County. Toward the end of the year the enlargement of the mill at Bishop was undertaken, with a view to increasing its daily capacity from 125 to 500 tons. The Capitola Mining Co. was declared bankrupt, and in August the property was purchased by W. H. Mann, of Pasadena, Calif.

Colorado.—The Wolf Tongue Mining Co., the Tungsten Production Co. (Inc.), the Clipper Tungsten Co., and George W. Teal continued to work the ferberite deposits near Nederland, Boulder County. A custom mill at the mouth of Boulder Canon was remodeled by R. A. Mann, who expected to start running it early in January, 1930.

Montana.—The Jardine Mining Co., at Jardine, Mont., mined and milled a few tons of tungsten ore.

Nevada.—The Nevada-Massachusetts Co., in the Eugene Mountains, 12 miles northwest of Mill City, was again the largest producer of tungsten concentrates in the United States. The company purchased and consolidated the Pacific Tungsten, the Mill City Tungsten, and other properties near Mill City, in western Pershing County. The company started development of the Silver Dyke & Tungsten and Wagner mines early in June, and construction of a power line 6½ miles long from the plant to the Silver Dyke & Tungsten mine was nearing completion at the end of the year. A mill with a daily capacity of 75 tons was constructed, and it was expected that milling operations would start about March 1, 1930. The Tungsten Production Co. (Inc.), of Boulder, Colo., did some work on its properties in the Nightingale district. Wm. L. Esson reported a small production of tungsten concentrates from his property at Mina.

IMPORTS

The imports of tungsten ore and concentrates during 1929 were the largest in 10 years and were more than double those of 1928. During 1929 the United States imported 5,973,817 pounds of tungsten in ore and concentrates (equivalent to 4,978 short tons of concentrates carrying 60 per cent of WO_3), valued at $1,703,711, or $5.70 per short-ton unit, and 472,279 pounds of tungsten in ferrotungsten and other forms, which is more than four times the quantity of corresponding imports in 1928.

Up to the beginning of December imports were removed from bonded warehouses practically as rapidly as received. At the end of the year tungsten held in bond amounted to 1,041,320 pounds of WO_3, equivalent to 868 short tons of 60 per cent WO_3 concentrates.

The new tariff bill (act of 1930) provides for an increase in the duty on ore from 45 to 50 cents a pound of metallic tungsten content (from $7.14 to about $7.93 per unit of WO_3). No change was made in the rates on ferrotungsten but the phraseology of several paragraphs was clarified and amended in order definitely to cover the tungsten contents of high-speed steel scrap and various tungsten-containing products, as for example, tungsten sheets and wire, tungsten carbide, and cemented carbide tools. The rates on tungsten metal powder and chemicals were increased.

The imports of tungsten in various forms during the past 10 years are shown in the following table:

Tungsten ore, ferrotungsten and tungsten metal, tungsten alloys, and tungsten chemicals imported for consumption in the United States, 1920–1929 [1]

Year	Tungsten ore and concentrates [1]		Tungsten and ferrotungsten, tungsten chemicals, powder, and acid [1]		Ferrochromium-tungsten, chromium-tungsten, chromium-cobalt-tungsten (W content)		Tungsten-nickel and other alloys of tungten (W content)	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1920	3,897,600	$779,593	1,997,719	$1,180,829	-------	-------	-------	-------
1921	3,227,840	276,757	507,206	180,371	-------	-------	-------	-------
1922:								
Jan. 1–Sept. 21	3,301,760	279,190	1,037,069	380,732	-------	-------	-------	-------
Sept. 22–Dec. 31	-------	-------	30,876	13,254	-------	-------	885	$741
1923	-------	-------	78,972	25,907	-------	-------	49	2,258
1924	-------	-------	132,987	46,156	8,800	$2,702	71	536
1925	854,059	206,326	839,194	316,454	396	352	-------	-------
1926	2,534,636	566,996	330,365	116,879	18,795	7,822	71	417
1927	2,170,657	540,409	27,272	9,777	66	377	56	328
1928	2,855,990	672,199	112,474	46,552	71	1,753	304	2,544
1929	5,973,817	1,703,711	469,189	219,030	19	289	3,071	156,911

[1] Prior to Sept. 22, 1922, imports recorded as ore, alloys, etc.; beginning with change in tariff, recorded as tungsten content of ore, alloys, etc.

As in other recent years, the bulk of the ore imported into the United States originated in China, but there was a sudden and quite substantial resumption of imports from South America and also from Australia.

WORLD PRODUCTION

The world production of tungsten, as shown by the ores shipped or marketed, from 1925 to 1929, so far as statistics are available, is given in the following table, compiled by L. M. Jones, of the Bureau of Mines, from official reports.

World production of tungsten ore, 1925–1929, in metric tons of concentrates containing 60 per cent WO_3

Country	1925	1926	1927	1928	1929
North America:					
Mexico	----------	----------	----------	----------	11
United States	1,080	1,254	1,056	1,096	753
	1,080	1,254	1,056	1,096	764
South America:					
Argentina	4	11	10	24	63
Bolivia[1]	82	109	79	29	1.630
Peru	5	----------	----------	----------	----------
	91	120	89	53	1,693
Europe:					
Czechoslovakia	60	86	78	73	78
France	----------	26	22	5	(2)
Germany	161	----------	----------	----------	(2)
Great Britain (Cornwall)	1	20	12	96	27
Portugal	207	358	174	151	(2)
Russia[3]	9	22	10	(2)	(2)
Spain	26	123	164	158	213
	464	635	460	500	(2)
Asia:					
China[1]	6,708	7,989	5,666	8,283	(2)
Chosen	(2)	(2)	5	161	15
India (Burma)	849	1,634	1,277	843	(2)
Indo-China (Tonkin)	189	92	213	211	195
Japan	----------	19	49	54	(2)
Malay States—					
Federated Malay States	174	99	22	5	351
Unfederated Malay States	251	234	170	139	156
Netherland East Indies	27	9	22	8	10
Russia[3]	----------	22	32	(2)	(2)
Siam	127	10	8	(2)	(2)
	8,325	10,108	7,464	9,800	(2)
Africa: Southern Rhodesia	22	----------	33	15	28
Oceania:					
Australia—					
Central Australia[4]	----------	----------	----------	----------	20
New South Wales	8	----------	----------	----------	25
Queensland	5	1	3	29	22
Tasmania	207	98	176	209	180
Western Australia	----------	----------	----------	----------	(2)
New Zealand[1]	36	15	15	6	39
	256	114	194	244	286
	10,238	12,231	9,296	11,700	(2)

[1] Exports.
[2] Data not available.
[3] Year ended Sept. 30.
[4] Part of Northern Territory prior to division in 1927 into Central Australia and North Australia.

FOREIGN PRODUCTION

Bolivia.—During 1929 Bolivia exported 1,524 metric tons of tungsten concentrates, considerably more than the total for the period 1920 to 1928. Only 28 tons were exported in 1928.

Burma.—Burma exported 1,608 long tons of tungsten ore, valued at $805,893, during 1929, as compared with 1,201 tons, valued at $506,931, in 1928. During the quarter ended December 31, 1929, alone, the exports amounted to 695 tons, valued at $805,893. This is the largest amount exported in any one quarter since December, 1927, and is almost double the exports in any three months period in 1928. Shipments were chiefly to the United Kingdom.

Canada.—The Indian Path Mining Co. continued exploration of a deposit containing both scheelite and gold. The work consisted of trenching and the sinking of a shaft, which at the end of the year was down 75 feet. The property is located at Indian Path, near Riverport, Lunenburg County, Nova Scotia.

China.—In 1929 China again furnished the larger part of the world's tungsten. Despite political disturbances and complete disorganization of commercial relationships, production and exports were well maintained. Some years ago a number of concerns engaged in tungsten production and distribution in China united for cooperative marketing and financing the movement of the ore. This work was done largely through the China Commercial Co., whose ore buyers were distributed at numerous points in and near the tungsten-producing districts and marketing centers. In the early part of 1929 one member (the United Tungsten Mining Co.) of this group withdrew and in June succeeded in obtaining from the respective provincial authorities a monopoly of the tungsten exports of Kiangsi and Kwangtung, the two leading producing provinces. The national government, however, did not approve the action of the provincial authorities and in particular opposed the giving over to one company the stocks of ore owned by another company. In October the Kwangtung monopoly was cancelled, and in November the Kiangsi contract was abrogated. The provincial authorities then announced that they themselves would take over the monopoly. They failed, however, to float a loan to finance these operations on government account, and in consequence experienced considerable difficulty in carrying on the business effectively. The mines continued to produce more or less as usual, but virtually the only shipments were those of the United Tungsten Mining Co., which had finally been permitted to export the remainder of the ore which it had collected during the period its contract had been in force. Several American and European firms bid for the monopoly, and the Canton Foreign Chamber of Commerce attempted to devise ways and means whereby the tungsten ore business could be placed on a safer basis for the exporters.[6] At the close of the year no satisfactory arrangements had been made.

Mexico.—In the last quarter of 1929, 14,700 pounds of tungsten ore, valued at $12,098, was exported from the Nogales district. Most of this ore had been in storage since it was produced in the vicinity of Nacozari about 10 years ago.

PRICES

Domestic prices of wolframite in 1929 ranged from $11.60 to $16 per unit of WO_3, the peak being reached in August. There was an apparent scarcity of ore, and from June until the end of the year all quotations were based on future deliveries. World prices advanced from $3 to $8 during the first seven or eight months.

HARD TUNGSTEN ALLOYS

The use of cemented tungsten carbide tools and dies has advanced rapidly. Several varieties of tungsten carbide are on the market—"carboloy," made by the Carboloy Co. (Inc.); "widia," made by the Krupp Co., in Germany, and sold in the United States by Thomas Prosser & Son; "dimondite," a product of the Firth Sterling Steel Co.; "hastellite," made by the Haynes Stellite Co.; and "Strauss metal," manufactured by the Ludlum Steel Co. The preparation of cemented tungsten carbide has been described by Zay Jeffries [7] as follows:

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[6] U. S. Bureau of Foreign and Domestic Commerce, Foreign Trade Notes: No. 285, Mar. 31, 1930, p. 7.

> The present cemented tungsten carbide is produced by first manufacturing a very fine powder of tungsten carbide. The fine powder is then mixed with metallic cobalt. The mixture is then ball-milled, the action causing the cobalt to be smeared over the surface of the minute microscopic particles of the carbide. The mixture, after ball-milling, is then pressed into any desired shape and size. It may be partially sintered, then by heating to a low temperature in which condition it can be handled without breaking, and can be easily shaped with a steel tool. It is not really machinable in the sense that the metal can be cut by an ordinary tool, but partially sintered powder can be removed with ease.
>
> The final sintering is done in an electric furnace with a hydrogen atmosphere at a brilliant white heat. This is the true cementing operation and cobalt is the cementing material. It is known that the cobalt takes up a little of the tungsten carbide in the process, but essentially the finished product consists of minute particles of tungsten carbide cemented together with cobalt or with cobalt containing some tungsten and carbon.

The several different grades of cemented tungsten carbide on the market are made in different ways and differ in physical properties. One grade, which has at times a calculated tensile strength of 300,000 pounds per square inch and a compressive strength, which, according to one determination, is as high as 540,000 pounds per square inch, contains about 87 per cent of tungsten carbide and 13 per cent of cobalt. Another grade, which is said to be harder but not so strong, contains about 6 per cent of cobalt. The present rather high selling price of $450 per pound will probably be reduced in the future, as the use of cemented tungsten carbide increases and production costs drop.

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"The world output of W is 8,000 tons per annum. Both Europe and the United States import the ore; it occurs in Asia, South America, and Australia, as wolframite $(Fe\ Mn)\ WO_4$ and scheelite, $CaWO_4$. Metallic W is employed for the cores of carbon electrodes to increase their conductivity, and it has a limited use for ovens of temperature 2,000 to 3,000° C. In alloys it confers acid-resistance and hardness. The tungstates are used in X-ray work, in making fireproof material, and in the preparation of lakes."

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"A discussion of the effect of additions of Ni, Cr, W, Mo, V, Ti, Cu, and Al."

BRECHT, K. G., SCHERER, R., and HANEMANN, H. Tungsten steel for magnets. Stahl u. Eisen, vol. 49, 1929, pp. 41–42. Chem. and Ind. (London), vol. 48, March 15, 1929, p. 211.

"The most suitable heat treatment for a tungsten steel of the following composition has been investigated: 0.67 per cent C, 0.26 per cent Si, 0.25 per cent Mn,

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[7] Jeffries, Zay, The Present Status of Cemented Tungsten Carbide Tools and Dies: Metals and Alloys, vol. 1, November, 1929, p. 222.

0.4 per cent Cr, and 6.62 per cent W. The best working properties were obtained by annealing at 650° and quenching in water, but the highest magnetic properties were obtained only after soaking for sufficient time at 820°."

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KOSAKI, MASATAKE. Rare earths of Japanese wolframites. Bull. Inst. Phys. Chem. Research (Tokyo), vol. 7, 1928, pp. 540–542. Chem. Abs., vol. 23, March 20, 1929, p. 1369.

"Wolframites from : (1) Takatory, Hitachi Province, and (2) Akenoba, Tajima Province, were fully analyzed giving, resp.: WO_3 70.47, 77.12, MnO 10.55, 0.81, FeO 10.00, 17.52, Fe_2O_3 2.65, 1.61, Al_2O_3 5.71, 2.02, SiO_2 0.89, 0.18, SnO_2 0.09, 0.34, P_2O_5 0.33,—,rare earths 0.04, 0.10 per cent. The mineral from Akenobe is therefore the ferberite variety of wolframite. The spectral analysis shows that the Takatory specimen contains Sc, Yt and Ho, the lines of the latter being predominant. It agrees thus with wolframite from Zinnwald, Bohemia, in containing Sc as a minor constituent."

LONG, H. J., and EDDY, W. P. Tungsten carbide as a cutting-tool material, Mech. Eng., vol. 51, August, 1929, pp. 596–597. Metals and Alloys, vol. 1. October, 1929, p. 182.

"The authors give some experiences in design, and fabrication and application of tungsten carbide tools, which must be very different depending upon their application. Some samples of successful and unsuccessful applications are given, showing that in the right place production can be increased by many hundred per cent over that in turning with high speed steels. Malleable cast iron, gray cast iron, alloy steels, bronze and bakelite could be machined very successfully. The application in automatic screw machines on the other hand is of no use. Modification of machine tools is necessary."

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"Several thousand tons of Russian deposits of wolframite, scheelite, and molybdenite are sufficient to meet the demands of the native electric incandescent lamp industry as it requires only a few tons of Mo and W a year. Production and manufacturing methods are essentially the same as those used in America."

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Spencer, Frank C. Tungsten-carbide as cutting material. Abrasive Ind., vol. 10, 1929, pp. 23–24. Jour. Am. Ceram. Soc., vol. 8, September, 1929, p. 671.

"At the present time there are two tungsten-carbide products available in the U. S., Carboloy, manufactured and sold by the Carboloy Co., N. Y., and Widia, manufactured by the Krupp Co., Essen, Germany, and imported by Thomas Prosser & Sons, N. Y. In addition to Carboloy two other brands will be manufactured in the United States, Strauss metal and dimondite. Strauss metal will be a product of the Ludlum Steel Co., while dimondite will be manufactured by the Firth-Sterling Co. This brand has not yet appeared on the market although an extensive development program is being carried on. The article is an abstract from a paper presented at the A.S.M.E. meeting in Rochester, May, 1929."

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——— (to Guardian Metals Co.). Tungsten alloys. U. S. Patent 1698212, January 8, 1929. Chem. Abs., vol. 23, March 10, 1929, p. 1104.

"Alloys containing over 60 per cent W and containing 10–25 per cent Ni and which also may contain C or carbides and Cu are incased in a different metal such as Cu which has a materially higher heat conductivity than the W-Ni alloy, in order to form composite plates for safe or vault walls, etc."

Cox, J. L. Steel alloy. U. S. Patent 1711519, May 7, 1929. Chem. and Ind. (London), vol. 48, July 19, 1929, p. 562.

"A forgeable steel alloy contains 0.35–1.5 per cent C, 4–20 per cent Cr, 6–18 per cent W, and 1–6 per cent Al. The chromium content is at most four times that of tungsten, and that of tungsten at most six times that of aluminum."

Diener, O. Lathe tools made of tungsten containing over 3 per cent carbon. British Patent 294086, February 15, 1928. Chem. Abs., vol. 23, April 20, 1929, p. 1863.

"B up to 0.2 per cent, Si up to 1.5 per cent (or both B and Si in any proportion up to 1.5 per cent) may be present and the material may be prepared from W powder containing the desired C, under high temperature and pressure."

Falkenberg, Heinrich. Tungsten alloy. U. S. Patent 1703577, February 26, 1929. Chem. Abs., vol. 23, April 20, 1929, p. 1864.

"Metallic W is melted with approximately an equal quantity of an alloy of Pb and Sb in the presence of small quantities of Fe, the mixture is diluted by the addition of further quantities of Pb-Sb alloy and the resulting mixture is fused with a mixture of metals containing Pb and a metal such as Sn, Sb, and Cu of higher melting point than Pb. The resulting alloy is suitable for bearings or ammunition."

Fonda, Gorton R. (to General Electric Co.). Tungsten composition suitable for incandescent lamp filaments. U. S. Patent 1721383, July 16, 1929. Chem. Abs., vol. 23, September 10, 1929, p. 4153.

"A composition which has long life and high-lighting efficiency consists mainly of W and also contains less than 1 per cent of Th oxide and B nitride."

Goldsmith, M. M., and Falck, W. H. (to Goldsmith Bros. Smelting & Refining Co.). Ruthenium alloy. U. S. Patent 1730003, October 1, 1929. Chem. and Ind. (London), vol. 48, November 22, 1929, p. 945.

"An alloy comprising about 75 per cent Ru, 17.5 per cent W, and 7.5 per cent Ni is claimed as a substitute for osmiridium."

Hoyt, S. L. (to British Thomson-Houston Co.). Hard alloys and carbides. British Patent 288521, April 6, 1927. Chem. Abs., vol. 23, February 10, 1929, p. 593.

"Compositions consisting of W, C, and Co, and W and Cu are referred to. W carbide may be first formed by heating W with finely divided sugar C or gas C or in CH_4 or illuminating gas. The carbide formed may be powdered and mixed with Co and the mixture placed in a C mold and heated to about 1,300–1,450° between electrodes while subjected to a pressure of about 1,000 lb. per sq. in. Instead of first forming W carbide, a mixture of W, Co, and C may be treated."

Johnson, J. Y. Manufacture of complex tungsten and molybdenum compounds (and pigments, color lakes, etc., containing them). British Patent 312975, March 3, 1928. Chem. and Ind. (London), vol. 48, August 16, 1929, pp. 643–644.

Kelley, F. C. (to British Thomson-Houston Co., Ltd.). Hard material for tools and dies. British Patent 303751, January 7, 1928. Chem. Abs., vol. 23, September 20, 1929, p. 4435.

"A mixture of W, Co, and C (with or without a temporary binder) or similar materials is heated to a sintering temperature. Various details are given."

Lederer, Ernest A. (to the Canadian Westinghouse Co., Ltd.). Refractory metals. Canadian Patent 284952, November 20, 1928. Chem. Abs., vol. 23, February 20, 1929, p. 809.

"Substantially pure refractory metals such as W or Mo are produced from the sulphides by pressing into slugs at moderate pressures and heating in a vacuum or in a reducing atmosphere such as H. The resultant slag consists of pure coherent metal. W produced in this way is entirely free from such impurities as O, C and S and when reduced in a vacuum is also free from H. In this extremely pure condition W is ductile and can be rolled, swaged, or drawn into wire."

Lorenz, Charles F. (to Westinghouse Lamp Co.). Crucibles of tungsten. U. S. Patent 1704256, March 5, 1929. Chem. Abs., vol. 23, April 20, 1929, p. 1785.

"Crucibles are formed of W powder sintered to W wool. Mo also may be used."

Metallabor A.-G. Manufacture of tungsten-carbon alloys for tools. Swiss Patent 126013, June 23, 1927. Chem. Abs., vol. 2, February 20, 1929, p. 813.

"C in an amount not exceeding 3 per cent is supplied to the metal during its fusion at a temperature at which the metal is passing from the pasty to the liquid state. An addition of an auxiliary metal, particularly Ta, may be made, and fusion may be effected in an atmosphere of N."

Mills, Oscar L. Tungsten alloys. U. S. Patent 1721966, July 23, 1929. Chem. Abs., vol. 23, September 20, 1929, p. 4414.

"In carrying out a continuous process, a W compound including W oxide 3–20 per cent is mixed with reclaimed W carbide alloy and metallic W 15–20 per cent and the mixture is fused by a C electric arc; waste material from the product is reclaimed in the form of W carbide and at least a portion of the reclaimed waste material is oxidized to form W oxide, which is used for continuing the process. An apparatus is described."

Remy-Stahlwerke, Stahl Schmidt & Co. Ges. Alloy steel for "high-speed" tools. British Patent 289990, February 28, 1927. Chem. Abs., vol. 23, February 20, 1929, p. 813.

"An alloy steel is specified containing W 17, Cr 5, V 1.5, Ta 7, and C 0.9 per cent, with or without Mo 2 per cent."

Romanelli, Emilio (to Westinghouse Lamp Co.). Apparatus for heat treatment of bars of tungsten or other metals. U. S. Patent 1698824, January 15, 1929. Chem. Abs., vol. 23, March 10, 1929, p. 1102.

Schroter, Karl (to General Electric Co.). Tools of hard-metal alloys. U. S. Patent 1728909, September 17, 1929. Chem. Abs., vol. 23, November 10, 1929, p. 5152.

"Solid bodies are formed from a mixture of very hard metal carbide powders melting above 2,000° such as W carbide and soft metal powders such as Co, Ni, or Fe by application of pressure; these solid bodies are sintered at 700°–1,100° and shaped to form tools and are then sintered at a temperature above 1,100° (suitably about 1,400°)."

Stahlwerke Rochling-Buderus A.-G. Tungsten carbide. Swiss Patent 126729, January 18, 1926. Chem. Abs., vol. 23, February 20, 1929, p. 813.

"Hard tools and like objects are made from W carbide, by mixing a small quantity of Th carbide with W, fusing with C, and molding."

Zschocke, Karl W. Filaments manufactured from tungsten, molybdenum and other difficultly fusible metals at a temperature below 1,000°. Austrian Patent 113453, January 15, 1929. Chem. Abs., vol. 23, September 10, 1929, p. 4153.

"Mechanical and manipulative features are given."

RADIUM, URANIUM, AND VANADIUM

FOREWORD

After furnishing the bulk of the world's supply for almost 10 years the United States virtually ceased to produce radium in 1923, when the output from the much richer ores of the Belgian Congo was placed upon the market. Since 1923, the Union Minière du Haut Katanga has had virtually a monopoly of radium production and distribution throughout the world. The prevailing impression has been that the Congo ores were so abundant and so high-grade that it would be hopeless to attempt to produce radium elsewhere. The report of the subcommittee on radium appointed by the British Government and made public early in 1929 did not wholly confirm this conclusion and tended to encourage gradual reawakening of interest in radioactive ores throughout the world. It remains to be seen whether the renewed prospecting and development work and sundry financial negotiations undertaken in 1929 will result in any substantial increase in production from outside sources, but for the moment, at least, the possibility of resumption of radium production in the United States, Australia, and Portugal on a fairly large scale appears far less remote than it did a year ago. Late in 1929 came the report of a discovery of radium-bearing ores in Ontario that the Canadian Department of Mines considered of possible commercial importance.

Uranium is the mother of radium, or, more accurately, the leading maternal ancestor; consequently uranium is present in all radium ores and may be recovered as a by-product. In the United States, vanadium also is a potential by-product of radium extraction; recently, in fact, it has been the sole product. American ores range from carnotites relatively rich in uranium and radium and low in vanadium to roscoelites which contain little or no uranium or radium but are relatively rich in vanadium. It has recently proved profitable to work domestic deposits for vanadium and the recovery of radium from the residues from vanadium extraction is one of the possibilities being considered in connection with proposals to revive an American radium industry.

RADIUM AND URANIUM

UNITED STATES

In 1929 Congressman Clyde Kelly, of Pennsylvania, introduced a bill authorizing the United States Bureau of Mines to undertake the production of 1 gram of radium for the treatment of patients in hospitals under the jurisdiction of the Veterans' Bureau. An appropriation of $100,000 was specified to cover the cost of plant research and operating expense. Hearings on this bill by the House Committee on Mines and Mining were held early in 1930, and eventually the committee tabled the bill temporarily pending an investigation of domestic deposits to be undertaken by the United States Geological Survey during the summer of 1930 and a report by the Bureau of Mines upon suitable methods of recovery.

Shipments of uranium ores aggregating 13 short tons were made by two companies in 1929. The Yellow Circle Mining Co., of Moab, Utah, sold small lots of carnotite ore containing 6 to 30 per cent of uranium oxide to buyers in various parts of the country for therapeutic purposes. John H. Overall made shipments of high-grade carnotite to Denver. The Pittsburgh Radium Co. is reported to have decided to start mining from its claims near Thompsons, Grand County, Utah. In October, Walter Ware was unwatering the Kirk mine, in Leavenworth Gulch, Gilpin County, Colo.; this old property, which has yielded considerable pitchblende as well as gold, has been idle for many years. Assessment work was done on claims of the Master Alloy Mining & Milling Co., at Goodsprings, Nev.

IMPORTS

Imports of radium were normal in 1929, amounting to 10.69 grams of radium salts having a reported value of $579,085, or about $54,170 a gram. As the result of a new vogue for yellow and brown glassware the imports of uranium oxide and salts increased largely. Available statistics for 1926 to 1929 are as follows.

Uranium and radium salts imported for consumption in the United States, 1926–1929

Class	1926		1927		1928		1929	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Uranium oxide and salts of ----------pounds--	53,411	$46,974	67,692	$58,971	165,378	$145,557	272,913	$344,548
Radium salts--------grams[1]--	10.97	548,788	7.259	393,140	10.97	566,977	10.69	579,085
Radioactive substitutes------	(2)	671	(2)	522	(2)	2,913	(2)	183
	----------	596,433	----------	452,633	----------	715,447	----------	923,816

[1] Bureau of Foreign and Domestic Commerce publishes quantities as follows: 1926, 169 grains; 1927, 112 grains; 1928, 169 grains; 1929, 165 grains.

(2) Weight not recorded.

FOREIGN DEVELOPMENTS

In June active negotiations were in progress to perfect and finance a merger of radium interests in Cornwall, South Australia, and Czechoslovakia. It was proposed to form a company, to be known as the English & Overseas Radium Merger (Ltd.), with a capital of £1,500,000, and to offer stock for public subscription in October. In the autumn, however, due to the unfavorable turn in the investment market, the underwriting syndicate postponed its plans.

Except for a little development work, the South Terras mine in Cornwall was practically at a standstill in 1929. An excellent description and history of the Cornish deposits were published by Robertson and Dines.[8] In Czechoslovakia the State-owned mines at Jachymov (Joachimsthal) were operated at a loss of approximately $55,000 (1,700,000 crowns) in 1929. Mining was resumed at the Svornost mine, which has been under water for many years. The radium content of the ore proved disappointing, but a new radioactive spring was discovered in this mine, enlarging the supply of curative waters at the Jachymov watering place.[9] In Portugal, prospecting was more active than it has been in many years. The Urgeiriça mine, belonging to Portuguese interests, was reported sold to British capitalists who commenced active development. British interests were also opening up concessions near Belmonte.[10] The Portuguese uranium lodes lie generally in a cup-shaped basin near the Spanish border. Within this area the Portuguese Mines Department has definitely granted some 90 concessions of 50 hectares (approximately 124 acres) each.[11] Under Portuguese law concessions are not granted until an investigation by the Mines Department indicates at least superficial evidence of the existence of the specified mineral. As yet, however, only about half a dozen concessions have been properly prospected. Nevertheless, Portugal has produced considerable radium. The ore is chiefly low-grade autunite, and the radium is not in equilibrium with uranium. For this reason radium mining in Portugal was at a rather low ebb even before the advent of Belgian production.

The Union Minière du Haut Katanga reported the production of 45 grams of radium in 1929. Sales aggregating 40 grams of radium during 1928 were reported—a figure much higher than for any previous year. Later sales figures have not been made public, but it was rumored early in the year that sales during the first few months of 1929 alone exceeded those for the entire year preceding, and the increase in production tends to confirm these rumors. There was some interest in the exploitation of pitchblende deposits in British Africa, and it was reported that a company had been formed to investigate deposits in the Gordonia district and in southwest Africa, but so far as known there was no production in Africa outside the Belgian Congo.

The Australian Radium Corporation, owning properties at Mount Painter, South Australia, was one of the companies included in the proposed radium merger. With the aid of local financing considerable development work was done, and a new road was built. A report on the company's properties (2,560 acres) by L. J. Winton, chief inspector of mines, was made public during the year.[12] The following summary is extracted from this report.

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[8] Robertson, T., and Dines, H. G., The South Terras Radium Deposit, Cornwall: Min. Mag. (London), vol. 41, September, 1929, pp. 147-153.

[9] U. S. Bureau of Foreign and Domestic Commerce, Foreign Trade Notes: No. 281, Feb. 26, 1930, p. 11.

[10] Mining Journal (London), vol. 166, Sept. 14, 1929, p. 740.

[11] Mining Journal (London), vol. 165, Apr. 13, 1929, p. 279.

> The field over which occurrences of radium-bearing minerals can be found is an extensive one, and though numerous occurrences have been discovered and prospected in this area, very little proper development has been done. Consequently, no estimates of large tonnage of available ore of known grade can be made, as, lacking the necessary facts to base these on, such estimates are absurd and misleading.
>
> It seems quite possible, however, that proper development of some of the places may prove them capable of yielding supplies of ore of a suitable grade, and the energy of the company should be directed toward that end, on the lines suggested in this report.
>
> In the past a limited quantity of ore was found, rich enough to be hand-picked and dispatched for sale, but no quantity of such is known at present, and future success appears to depend mainly on the successful treatment of low-grade ore, very low grade as compared with known sources in other parts of the world. The best ore sampled was 1.74 per cent of uranium oxide, and taking the equilibrium ratio of uranium and radium at 320 milligrams of radium element per ton of uranium element, a ton of 1 per cent of U_3O_8 ore would, therefore, approximate to 4.7 milligrams of radium element per ton.
>
> Rich ore has been found in the past and new occurrences of such may be discovered in the future, but the general exposures of uranium minerals are of low grade, and an effective means of concentrating such ore to a profitable grade must be found, bearing in mind also the competition from other known sources of production.
>
> The extent of the field, the number of uranium mineral exposures throughout it, and the former discovery of rich ore are, however, facts which fully warrant further development and exploration.

MISCELLANEOUS ITEMS

A novel use of radium is reported in a Russian rubber factory.[13] In the manufacture of rubber-covered fabric enormous charges of static electricity are produced by friction and constitute a serious fire hazard, especially where highly explosive vapors are present. This is prevented when radium is placed near the point where the electricity is generated; the radium rays ionize the air, making it conductive, so that dangerous charges flow harmlessly to the nearest metal ground connection. The cost is very low, because 1 milligram of radium will last for several centuries. In the British Isles a national radium fund was started for the purchase of at least 24 grams of radium, partly by popular subscription. The Government of Latvia granted the Latvian University 18,000 lats for the purchase of 100 milligrams of radium for the treatment of cancer patients in Latvia. An additional 15,000 lats was provided for a similar purchase during the fiscal year beginning April 1, 1930. In November, 1929, Madame Curie visited the United States and received a donation of $50,000 to be used for the purchase of a gram of radium for use in the hospitals of Poland, her native land.

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The following articles and patents relating to radium and uranium appeared or became available in 1929.

Botolfsen, Erling. Production of pure uranium. Bull. soc. Chim., vol. 45, 1929, pp. 626–7.

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[12] Winton, L. J., The Australian Radium Corporation: South Australian Min. Rev., Dept. Mines, Adelaide, Report 50, for half year ended June 30, 1929, pp. 63–75.

[13] Browning, Phillip E., Foote-prints: Vol. 2, No. 1, 1929, pp. 28–29.

Eisentraut, O. Uranium and radium ore deposits of Katanga. Ber. Freiberger Geol. Ges., vol. 22, 1927. Chem. Abs., vol. 23, November 10, 1929, p. 5096.

"A description of the mines in Katanga which produce radioactive minerals."

Fenner, Clarence N. Analytical determination of uranium, thorium, and lead, as a basis for age-calculations. Am. Jour. Sci., vol. 16, 1928, pp. 369–381. Chem. Abs., vol. 23, July 10, 1929, p. 3154.

"Detailed directions are given for the determination of U, Th, and Pb in radioactive minerals such as euxenite, polycrase, samarskite and monazite."

——— Radioactive minerals from Divino de Ubá, Brazil. Am. Jour. Sci., vol. 16, 1928, pp. 382–391. Chem. Abs., vol. 23, July 10, 1929, p. 3154.

"A specimen of monazite from Divino de Ubá contained 5.091 per cent Th and 0.0927 per cent Pb, from which its age is calculated to be 3.6 x 10^8 years. The age of samarskite from the same source is 3.4 x 10^8 years, reckoned from its content of 10.88 per cent U, 1.64 per cent Th, and 0.52 per cent Pb."

Fuba, Kitsuzo Research Lab., Tokyo Elec. Co. Study of the coloring of glass. Jour. Mazda Research Lab., vol. 3, 1928, pp. 21–49. Chem. Abs., vol. 23, April 10, 1929, p. 1731.

"U is used for making yellow glass, and the recent observation that the glass absorbs ultra-violet rays opened a wide field for its application. Na uranate, $UO_2(OAc)_2$, Na uranate+an oxidizing agent, Na uranate+As_2O_3 were tested. The use of WO_2 or Na uranate causes no great difference with phosphoresence, but the luster is best with Na uranate. 1–2 per cent UO_2 salt gives a greenish yellow color; with 5 per cent deep yellow or orange to brown color is produced in some glass, the coloration being different with the kinds of glasses. Glass containing Na uranate fluoresces in different degrees, K glass more strongly than Na glass. If the glass contains boric acid, it has a strong fluorescence. K–Mg glass and K–Zn–B–SiO_2 glasses have always a beautiful fluorescence. The addition of As_2O_3 to Na uranate has no influence."

Hahn, Otto. Radium. German Patent 472,857, August 16, 1924. Chem. Abs., vol. 23, June 20, 1929, p. 2888.

"Stable Ra preparations with high emanating properties are prepared by treating Ra salt solutions with solution of substances which, with a common precipitating agent, give a precipitation with a greater surface. Thus, $RaBr_2$ is mixed with La $(NO_3)_3$ and HF added. The RaF_2 produced is stable and of good emanating quality. $FeCl_2$ and $RaBr_2$ may be precipitated with NH_4OH. Other examples are given."

Hindes, Gwendolyn. Radium. Pharm. Jour., vol. 123, 1929, pp. 233–4. Chem. Abs., vol. 23, November 10, 1929, p. 5096.

"A review of the history of the discovery of radium, its properties, and therapeutic importance."

Marden, John W., Thomas, Thomas P., and Conley, John E. (to Westinghouse Lamp Co.). Refractory metals such as uranium and thorium. U. S. Patent 1704257, March 5, 1929. Chem. Abs., vol. 23, April 20, 1929, p. 1865.

"In order to obtain metals such as U or Th from their difficultly reducible oxides, the latter are heated to a reacting temperature with Ca or other alkali earth metal and an alkali earth metal halide such as $CaCl_2$."

Moran, William G. Two simple methods of purifying radium emanation. Am. Jour. Roentgenol. Radium Therapy, vol. 22, 1929, pp. 147–50. Chem. Abs., vol. 23, November 10, 1929, p. 5096.

"A simple apparatus for the purification of Ra emanation is described, which is low in cost and easy of operation. The use of liquid air is avoided and the removal of water vapor is unnecessary. In one method of purification the O and H are ignited with a hot CuO_2 filament which also oxidizes the excess H. In the other an electric spark is used. The concentration obtained compares favorably with that obtained with complicated and expensive installations."

Parsons, A. T. Radium, with special reference to luminous paint. Jour. Oil and Color Chem. Assoc., vol. 12, 1929, pp. 3–25. Chem. and Ind. (London), vol. 48, March 29, 1929, p. 254.

"A general account of the chemical and radioactive properties and the manipulation of radium is given, and its applications to medical practice and chemical investigations are indicated. Radioactive luminous paints consist of a phosphorescent body, e. g., suitably prepared zinc sulphide, etc., the luminescence of which is excited by radioactive material, e. g., radium, mesothorium, etc. The manufacture of luminous zinc sulphide is described. Work on the permanence of luminous paint and the recovery of radium therefrom is summarized."

Piggot, Charles S. Radium in rocks. I. Radium content of some representative granites of the eastern seaboard of the United States. Am. Jour. Sci., vol. 17, 1929, pp. 13–34. Chem. Abs., vol. 23, April 10, 1929, p. 1565.

"A weighed amount of pulverized rock was decomposed in a stream of pure dry CO_2 gas by fusion with mixed Na and K carbonates. The gases were scrubbed by an aqueous solution of 1 NaOH: 3: 5 aq. passed over stick NaOH and collected over Hg. Rn was determined by an emanation electroscope. The granites examined and their respective Ra contents were (all X 10^{-12} g. per g. rock), Stone Mountain, Ga. (muscovite), 4.826; Mount Airy, N. C. (biotite), 0.655; Woodstock, Md. (biotite diorite, with epidote), 1.448; Milford, Mass. (pink mottled biotite), 0.378; Rockport, Mass. (hornblende biotite), 0.955; Hurricane Island, Me. (biotite), 3.74. The analyses for these rocks are given. The Ra content is considered to be associated with minerals of high specific gravity and particularly with the interstices between and the surfaces of grains. Part of the radioactivity can be extracted by hot water."

——— Radium and geology. Jour. Am. Chem. Soc., vol. 50, 1928, pp. 2910–6. Chem. Abs., vol. 23, March 10, 1929, p. 1048.

"The significance of radioactivity to geology is discussed. The radioactivity of 7 granites of the eastern United States is given. A method for determining U and U-derived Pb involved in an age determination is outlined."

Robertson, T., and Dines, H. G. The South Terras radium deposit, Cornwall. Mining Mag. (London), vol. 41, September, 1929, pp. 147–153.

Spa-Monopole Compagnie Fermière des Eaux et des Bains de Spa. Treating water or other liquids with radium emanation. British Patent 298915, October 15, 1927. Chem. Abs., vol. 23, June 20, 1929, p. 2888.

"The emanation is conveyed by a current of gas (such as purified air) circulating in a closed system in an apparatus which is described. A potash bulb removed CO_2 and any explosive gas which may be formed is destroyed by Cu oxide or platinized asbestos in a heated tube."

Wolf, P. M., and Riehl, N. A novel simple process for manufacture of concentrated radium emanation preparations. Naturwissenschaften, vol. 17, 1929, pp. 566–567. Chem. Abs., vol. 23, November 10, 1929, p. 5096.

"Some species of adsorbent carbon have a distribution coefficient relative to air of as much as 1700 for Rn. A simple apparatus is described for the transfer of this gas from a Ra salt to a small gold or glass capillary container filled with active C; the adsorption is 90 per cent. For the Ra preparation the strongly emanating Hahn substances were used which consist of Ra adsorbed on Fe hydroxide gel. The preparations of Rn made in this manner had activities up to 0.5 to 2 millicuries per cm. length; they are most useful for tumor therapy."

Worsley, A. The radioactive ores of Britain. Mining Jour. (London), vol. 164, 1929, pp. 201–2. Chem. Abs., vol. 23, June 20, 1929, pp. 2910–11.

"The possibility of establishing a plant for producing Ra in Great Britain is considered. The composition and occurrence of pitchblende, torbernite, autunite, bassetite, uranospathite, carnotite and a columbo-titanate of U from Madagascar. Devon and Cornwall are the districts in which search should center."

VANADIUM

The consumption of vanadium in the United States in 1906 was about 750 pounds and in 1924 about 1,000,000 pounds. The estimate for 1930 is 1,800,000 pounds, with an additional 800,000 pounds to be used in other countries. Over 90 per cent of the world's supply is under American industrial control, but only about 16 per cent of it occurs in deposits within the borders of the United States.[14]

Vanadium is used principally in the steel industry, especially in alloy steels employed by the automobile industry and by the railroads. Diversified applications also have been developed in other industries, and at present vanadium oxide (or compounds made therefrom) is used more or less extensively as a catalytic agent, especially in the manufacture of contact sulphuric acid and phthalic anhydride; in pharmacy and therapeutics; in driers for the varnish and linoleum industries; as insecticide, fungicide, and fertilizer (soil inoculation); in photography; in dyeing; as an accelerator in rubber; and in the glass and ceramic industries.

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[14] Partridge, Everett P., Research within an Industry Creates the Demand—and Supplies It: Ind. and Eng. Chem., vol. 21, 1929, pp. 37-40.

In steel vanadium was formerly described ordinarily as a scavenger but it is used now as an alloying agent. Cheaper alloys may be employed for deoxidizing purposes whereas vanadium has a peculiar field of use in controlling grain size. In high-speed steel it also acts as a stabilizer of the carbides. While carbon-vanadium and chrome-vanadium steels are the types of vanadium steels generally used for structural purposes and machinery parts other alloy combinations exhibit valuable properties; nickel-vanadium steel, for example, is used to some extent in locomotive frames and silicon-vanadium steel is used in railroad springs. The fine grain size induced by vanadium is taken advantage of in making castings as well as forgings, and normalized carbon-vanadium steel may replace quenched and tempered carbon steel, thereby obtaining similar physical properties in the finished article with less trouble from warping in manufacture, reduced rejections, and a greater absence of straightening strains.

DOMESTIC PRODUCTION

Results of drilling in the roscoelite areas of Colorado in recent years have revealed much larger reserves of vanadium than were formerly believed to exist in the United States. The Bureau of Mines is not at liberty to publish figures for production of vanadium ores in 1929. As in former years, the United States Vanadium Corporation, a Union Carbide subsidiary, was the leading producer, the concentrates from its Colorado operations being shipped to eastern plants of the same organization. This company is reported to have purchased the Long Park holdings of the Vanadium Alloys Corporation adjoining its previous holdings, which were acquired some years ago from the Standard Chemical Co. The Vanadium Alloys Corporation, with claims in Garfield and Mesa Counties, Colo., did only assessment and development work in 1929, and the same was true of the United States Co. of New Jersey, whose holdings in San Juan County, Utah, were subsequently taken over by the Vanadium Alloys Corporation. The Rare Metals Corporation, after doing development work in 1929, mortgaged its claims in Montrose County, Colo., to the Vanadium Corporation of America and undertook the building of a mill 3 miles from Naturita on the San Miguel River. The International Vanadium Mining Corporation, which was formed by B. F. and R. A. Pitts, has taken over the properties of the Vanadium Alloys Corporation in Dry Valley, Utah, and also near Gateway and Rifle, Colo. A new mill being erected in Dry Valley was expected to come into production in July, 1930. The plans of the corporation include the construction of another mill near Grand Junction, Colo., to handle the ore from the Gateway claims. The Western Ore Supply Co. made several shipments of vanadium ore from properties in Colorado and Utah to the Interstate-Copartner mill in Denver. The railroad freight rate from both localities (Cisco, Utah, and New Castle, Colo.) to Denver mills is the same, amounting in 1929 to $5.50 a ton.

In Arizona E. C. O'Brien & Co. built a mill near Globe to handle near-by tungsten ores and treated several hundred tons of 2 per cent vanadinite ore from the Apache Vanadium Co. claims at Radium and from the Bywater mines at Dripping Springs. The concentrates, averaging 14 per cent of V_2O_5, were shipped to an eastern plant. The United Vanadium Corporation, with offices in Los Angeles, operated a small mill at Wickenburg and made trial shipments of gold-silver-vanadium ore to Europe (via San Pedro). About the end of the year this company took over the Bywater vanadium mines and proposed to erect a mill at the latter property also.

IMPORTS

The imports of vanadium ores into the United States over a series of years are shown in the following tables.

Vanadium ore (steel-hardening) imported for consumption in the United States, 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	20,673,296	$1,080,935	1925	4,735,461	$339,468
1921	10,307,540	543,061	1926	16,735,040	914,114
1922	611,170	86,776	1927	13,885,760	561,051
1923	4,177,115	229,210	1928	1,104,320	49,771
1924	14,116,596	722,731	1929	19,519,360	794,734

Vanadium ore (steel-hardening) imported into the United States, 1928 and 1929, by countries

Country	1928			1929		
	Ore		Value	Ore		Value
	Pounds	Estimated vanadium content (pounds)		Pounds	Estimated vanadium content (pounds)	
Germany	2,240	224	$159			
Peru	1,102,080	129,494	49,612	19,519,360	2,293,525	$794,734
	1,104,320	129,718	49,771	19,519,360	2,293,525	794,734

WORLD PRODUCTION

The world production of vanadium contained in ore or concentrates in 1928 and 1929 was apparently as follows:

World production of vanadium in ores and concentrates, 1928 and 1929

Country	1928		1929	
	Pounds	Value [1]	Pounds	Value [1]
Mexico	5,820	$2,910	(2)	(2)
Northern Rhodesia	113,656	56,828	131,290	$65,645
Peru	161,299	80,650	1,989,575	994,788
South-West Africa	753,919	376,960	685,504	342,752
United States	(3)	(3)	(3)	(3)

[1] Value arbitrarily fixed at 50 cents a pound for vanadium contained.
[2] Data not available.
[3] Bureau of Mines not at liberty to publish figures.

FOREIGN COUNTRIES

Activity at the Vanadium Corporation of America's mines at Minasragra, Peru, is indicated by recorded imports of vanadium ore into the United States from Peru amounting to 19,519,360 pounds in 1929, as compared with 1,102,080 pounds and 13,883,520 pounds imported from the same source in 1928 and 1927, respectively. The flotation plant, constructed in 1928, began operations in February, 1929, and during the year treated 20,980 metric tons of ore, from which was obtained 6,258 tons of concentrates with an average content of 18.66 per cent of V_2O_5.

In 1929 the United States received no imports from other countries; the South African output was apparently sent wholly to Europe.

Early in 1930 a bill was introduced in the Peruvian Parliament to nationalize all vanadium deposits as yet unworked and to levy a tax of 10 per cent on all operating mines.[15] A considerable distance south of Minasragra is a belt of carbonaceous shale 10 or 12 miles long and as much as 800 feet wide that averages from 0.5 to 0.7 per cent V_2O_5. This huge, low-grade deposit is in the plateau region between the coast ranges and the Andes and is crossed by the Central Railroad of Peru. Processes have been devised for extracting the vanadium, but evidently the profit margin is too small for the deposit to be classed as commercial ore under existing conditions.

The Rhodesian Broken Hill Development Co. (Ltd.) completed a large reduction plant, which did not get into full operation in 1929. Ferrovanadium will henceforth be produced, it appears, in Africa. The projected output is from 315 to 630 tons annually. Vanadium, in the form of descloizite with lesser amounts of vanadinite, occurs at Broken Hill in a well-defined marginal relationship to the oxidized ores of that district, principally in the broken ground between the massive oxidized lead-zinc ores and dolomite and in open fissures.

Next to Peru, South-West Africa is doubtless the leading source of vanadium. The lead-zinc vanadate formerly went in part to the United States but in recent years has been treated in Europe.

A Russian expedition has investigated the titaniferous magnetite deposits in the Yuberska district in the North Ural (Visherski) iron ore region, confirming previous reports that these deposits contain about 1 per cent of vanadium.

In 1928, the Año Nuevo mine near La Sierra de Los Lamentos, in Chihuahua, Mexico, produced 27 tons of ore containing 2,640 kilos of vanadium, part of which was shipped to Brazil.

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[15] Mining Journal (London), vol. 168, Feb. 22, 1930, p. 154.

Blackwood, P. W. The metallurgical aspects of cast iron. Trans. Am. Soc. Steel Treating, vol. 13, 1928, pp. 1023–1038. Chem. Abs., vol. 23, January 10, 1929, p. 72.

"A discussion of the effect of additions of Ni, Cr, W, Mo, V, Ti, Cu, and Al."

Hurst, J. E. Vanadium and titanium in cast iron. Foundry Trade Jour., vol. 41, 1929, pp. 173–4, 176. Chem. Abs., vol. 23, November 20, 1929, p. 5456.

"Previous investigations studying the influence of small additions of V and Ti to cast Fe are reviewed and valuable possibilities are discussed in the commercial development of cast Fe containing V and Ti."

Palmer, L. A. Vanadium and molybdenum compounds in clays. Jour. Am. Ceram. Soc., vol. 12, 1929, pp. 37–47. Chem. Abs., vol. 23, March 20, 1929, p. 1485.

"Eight light-burning clays and shales containing small quantities of insoluble and Mo compounds were studied. During slow firing, soluble salts of these elements were formed, which later appeared as a yellow-green efflorescence on the fired clay. The color was due chiefly to alkali vanadates. The use of either Na_2SiF_6 or CaF_2 was effective in eliminating the efflorescence."

Partridge, Everett P. Research within an industry creates the demand—and supplies it. Ind. and Eng. Chem., vol. 21, January, 1929, pp. 37–40. Chem. Abs., vol. 23, March 20, 1929, p. 1371.

"The function of the research department of the Vanadium Corporation of America in creating a demand for V and then supplying necessary material to manufacturers is shown. V used in the United States in 1906 was about 750 pounds, in 1924 about 1,000,000 pounds and the calculated demand in 1930 is about 1,800,000 pounds, with an additional 800,000 pounds to be used in other countries. Over 90 per cent of the world's supply is under American industrial control, although the ore comes chiefly from Peru and South Africa; only about 16 per cent of it occurs as mineral deposits within the United States. The recovery from V-steel and other alloys by the acid open-hearth furnace is increasing rapidly. Types of research problems are given, including the development of manufacturing processes for the corporation itself and the utilization of products made by it. Among the latest projects are the preparation of catalysts, medicinals, and rare chemicals of C. P. and technical grades. Cooperation with consumers of its products, with research as a consulting service, has given valuable results."

Scherer, A. Influence of cobalt, vanadium, and manganese on some properties of tool steel. Arch. Eisenhuttenwes, vol. 1, 1927, pp. 325–9. Chem. Abs., vol. 23, February 10, 1929, p. 585.

"The tests were carried out on eutectoid C steels containing increasing amounts of Mn, V, V and Si, Co, V and Co. Co steels were least affected by variations in quenching conditions, and particularly unaffected by excessive heating. They also exhibited least change in volume on quenching. The steels best suited for making tools are Co and V steels, which have both maximum hardness and minimum sensitiveness to hardening treatment."

PATENTS

Fox (Natural Color Picture Co.). Vanadium in photography. U. S. Patent 1685281. Foote-Prints, vol. 2, 1929, p. 33.

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Paul, Ira M. (to Metal & Thermit Corporation). Treating vanadium ores. U. S. Patent 1696923, January 1, 1929. Chem. and Ind. (London), vol. 48, March 15, 1929, p. 215.

"The ore is heated with crystals of sodium sulphide until the latter melt in their water of crystallization and the mixture finally dries to a solid mass. Extraction of this mass with water yields a solution containing the vanadium."

Saklatwalla, B. D. (to Vanadium Corp. of America). Ferro-vanadium. U. S. Patent 1715867, June 4, 1929. Chem. Abs., vol. 23, August 10, 1929, p. 3655.

"A ferro-V containing 85–95 per cent of V is prepared for use in making V alloy steels, etc."

——— Vanadium-aluminum-silicon alloys. U. S. Patent 1727180, September 3, 1929. Chem. Abs., vol. 23, November 10, 1929, p. 5152.

"Alloys which are suitable for addition to steel comprise V 40–90, Al 3–15 and Si 5–30 per cent, the remainder being principally Fe."

SAKLATWALLA, B. D. (to Vanadium Corp. of America). Ferro-vanadium, etc. British Patent 305201, February 2, 1928. Chem. Abs., vol. 23, October 10, 1929, pp. 4626–4627.

"Ferro-V containing 85–95 per cent V is made in an electric furnace by use of Si as reducing agent, or, preferably, by thermo-reduction of high grade V_2O_5 by use of Al. A product is obtained containing less than 1.25 per cent Si and less than 0.5 per cent C. British Patent 305202 describes a V alloy containing about 40–90 per cent V, 3–15 per cent Al, 5–30 per cent Si and the remainder principally Fe; or similar alloys may be substantially free from Fe, and the C present may be less than 0.5 per cent. These alloys may be made by thermo-aluminic reduction of V_2O_5 and may be used for introducing V into molten steel baths in which the Al and Si serve as deoxidizing agents."

MERCURY[1]

By Paul M. Tyler[2]

STATISTICAL SUMMARY

Summary of statistics for mercury in the United States, 1928 and 1929[1]

[Flasks of 76 pounds]

	1928	1929
Production ... flasks	17,870	23,682
Number of producing mines	54	63
Average price per flask:		
San Francisco	[2] $125.34	[2] $124.00
New York	$123.51	$122.15
London	£22 6s. 1d.	£22 5s. 2d.
Imports for consumption: pounds	1,106,736	1,133,721
Imports for consumption: equivalent in flasks	14,562	14,917
Stocks in warehouse (bonded) at end of the year ... flasks	5,476	3,593

[1] In former chapters on mercury in Mineral Resources of the United States quantities were expressed in terms of 75-pound flasks; in order to conform with present conditions the figures have been converted in the present report to their equivalent in 76-pound flasks.
[2] Beginning Oct. 27, 1928, quotations for San Francisco are on basis of "retail and small wholesale lots."

INTRODUCTION

In 1929 continued high prices stimulated activity in mercury mining in the United States and resulted in a further increase in production. The increase in output in 1929, although less marked than that in 1928, was substantial; the production was 23,682 flasks of 76 pounds, as compared with 17,870 flasks in 1928 and 11,128 flasks in 1927. Receipts from overseas declined by 1,086 flasks, but owing to a reduction in warehouse stocks the imports for consumption increased slightly, with the result that the increase in indicated consumption in the United States was slightly more than the increase in output from domestic mines. In fact, the apparent supply, which amounted to 38,500 flasks in 1929, was larger than in any previous year.

The control exercised abroad by the mercury cartel constituted the dominant feature of the situation. As unsold stocks continued to increase, production, particularly in Spain, was curtailed but prices were not lowered. Although the apparent consumption in the United States seems to be increasing, a larger and larger proportion of this consumption has in recent years been supplied by American mines; in consequence, imports have declined. All of the other large mercury-consuming countries likewise reported smaller imports in 1929. In most of the foreign countries, however, the reduction in consumption in 1929 is more apparent than real and is attributed to the accumulation of considerable stocks purchased in 1928 in anticipation of the formation of the cartel. Except in the United States, the stabilization of prices at a relatively high level has not resulted in a substantial increase in production from mines not controlled by the cartel.

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[1] Work on manuscript completed July, 1930.
[2] Unless otherwise stated, the statistics on the domestic industry in this report were prepared by H. M. Meyer and the data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines. E. P. Youngman, of the Bureau of Mines, assisted in assembling data from miscellaneous sources.

DISTRIBUTION OF DOMESTIC CONSUMPTION

Approximately 1,000 uses have been claimed for mercury, but in many of these uses substitutes may be employed. C. N. Schuette, in a report prepared for the Bureau of Mines, presents the results of a comprehensive analysis of the consumption of mercury in the United States in 1928. A comparison of this analysis with estimates for previous years shows that the striking feature is the great diversity of new uses. For many years the principal use of mercury was in connection with the amalgamation process for recovering gold, but now only a little more than 1 per cent of the domestic consumption is used for this purpose. Drugs and chemicals account for almost 40 per cent of the consumption, and fulminate used in blasting caps and ammunition consumes an additional 19 per cent. Next in importance as consumers of mercury are scientific instruments and electrical apparatus, followed in turn by vermilion, felt, caustic soda, and glacial acetic acid. The distribution of consumption by uses has been tabulated by Schuette as follows:

Mercury consumed in the United States in 1928, by uses

	Flasks of 76 pounds
Drugs and chemicals:	
Pharmaceuticals	5, 421
Dental preparations	357
Chemical preparations	7, 388
Seed disinfectants	360
	13, 526
Fulminate	6, 500
Vermilion	2, 418
Felt manufacture	1, 697
Amalgamation	447
Electrical apparatus:	
Lamps	1, 184
Rectifiers and oscillators	227
Primary and storage batteries, battery zincs, and standard cells	899
Rectifier bulbs and power-control switches	212
	2,522
Industrial and control instruments:	
Heat-control devices	201
Compensating clock pendulums	32
Gas-pressure and other tank gages	558
Gas-analysis apparatus	61
Flow meters	280

	Flasks of 76 pounds
Industrial and control instruments—Continued.	
Thermometers, barometers, and miscellaneous scientific instruments	144
Industrial-control apparatus not definitely specified	1,567
Vacuum pumps	114
	2,957
General laboratory use	620
Manufacture of caustic soda and glacial acetic acid	987
Various uses:	
Emmet boiler, boiler compound, fireworks, wood preservative, antifouling paint, and other miscellaneous uses	2,808
Total	34,482

NEW USES

No new uses of commercial significance were found for mercury in 1929, but practical results in the use of certain mercury-containing solders are reported in Great Britain.[3] For joining galvanized iron a solder containing 4 per cent of mercury, 3 per cent of tin, and 92 per cent of lead is said to have proved excellent. Other mixtures contain lead with 6 per cent of mercury and 3 per cent of tin, and lead with 8 per cent of mercury and 6 per cent of tin. Experience in British shipyards has demonstrated that these solders are equal or superior to ordinary lead-tin solders as regards flow and strength. The danger from mercury fumes is minimized as the solder melts at almost 200° F. below the boiling point of mercury.

As part of its program to extend the use of mercury and to liquidate its stocks of the metal, the sales bureau of the Mercurio Europeo has offered prizes aggregating £5,000 for the discovery of new uses for the metal or its compounds. The conditions of the offer include the following:

> The use must be new in the sense that it has not been previously known in industry, and its industrial utility must be established. It must be protected by patents taken out in the United States and Germany dated not earlier than January 1, 1930. The new application must result in an increased consumption of mercury of at least 1,000 flasks in the year 1933, 3,000 flasks in 1934, 5,000 flasks in 1935, and thereafter. The allocation of the prize will be intrusted to a prize commission, and the amount will become payable as the conditions become fulfilled, the first payment of £1,000 being payable at the discretion of the commission at an early stage but the remaining installments, each of £2,000, only as the extra sales of mercury due to the new use are reached, although the commission has the discretion of making such payments, if it so decides, before the stipulated quantities are reached.
>
> The proposals for new uses for the metal must be addressed in Spanish, Italian, English, or French to the Mercurio Europeo, Place St. François, 5, Lausanne.

METALLURGY

Probably more mercury-production plants were built in the United States in 1929 than in any previous year. Although there were no outstanding changes in design, numerous refinements were made in furnaces and condensing equipment. The trend is toward all-metal construction, and in many of the latest installations cast-iron pipe was used in the condensing systems.

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[3] Mason, William, Modern Solders and Their Applications: Chem. Eng. and Min. Rev., vol. 22, Feb. 5, 1930, p. 189.

Retorts have always been used at small plants. Before 1917 the Scott furnace was the standard means of treating mercury ore in the United States; later, however, this furnace has been displaced almost entirely by mechanical furnaces. At one or two properties Herreshoff or McDougall type furnaces equipped with extra oil burners have rendered excellent service, but probably 90 per cent of the ore now produced by domestic mercury mines is treated in rotary furnaces. The following notes on this type of furnace are digested from a descriptive bulletin (No. 3) issued in August, 1929, by H. W. Gould & Co., San Francisco, Calif.

> The furnace itself consists of a tube mounted on riding rings and trunnions and resembles a cement kiln or rotary dryer. Five sizes are built. The smallest, which is 18 feet in diameter and 16 feet long, has a capacity of 8 to 12 tons in 24 hours; and the largest, which is 5 feet in diameter and 75 feet long, can treat 90 to 150 tons in 24 hours. The actual tonnage depends, of course. upon the nature of the ore, a coarse granular ore being treated more rapidly than one that contains much clay or that is unusually fine. The ore is roasted in 30 to 50 minutes, and the plant can be shut down any time and then brought back to full capacity in less than two hours. In most districts the furnaces are fired with fuel oil, but gas, coal, or wood may also be used. The cost of a complete plant for treating mercury ore is relatively low as compared with smelting plants for other ores, ranging usually from $400 to $1,000 per ton daily capacity. Operating costs are likewise low. In a large plant one man per shift can handle 100 tons a day, and in California the average cost per ton of ore treated ranges from less than $1 for a large plant to around $2.50 for a small plant. The question is often asked why mechanical methods of concentration are not more extensively employed. Flotation plants are found at some mines, but because of the low cost of furnacing it is evident that the field for mechanical beneficiation is strictly limited. As a rule, any saving in treatment costs by reducing the tonnage put through the furnace would be largely offset by additional losses of mercury in the tailings rejected in the preliminary ore-dressing processes.

Improvements in the metallurgy of mercury have been reviewed by Duschak,[4] who summarizes his conclusions as follows:

> The direct furnace treatment of quicksilver ores remains the standard practice and when suitable attention is given to the design of the plant leaves little to be desired. The problem of treating a large tonnage of ore below the necessary furnace grade may be solved under favorable conditions by wet screening, followed by flotation and the retorting of the concentrate. There is a very apparent need for economical methods for use during the development of a property or where operations are necessarily on a small scale. Hand sorting and retorting have been the chief reliance in this connection. However, this practice is successful only where a relatively high-grade product, say 5 to 10 per cent Hg, can be economically produced by sorting. When this is not possible a small furnace plant or a small flotation plant and battery of retorts offer the best solution.

Recent work done at the Pacific experiment station of the Bureau of Mines has shown that except when mercury ores are "opalized" attrition concentration may be an effective means of raising the grade of the ore. When the cinnabar occurs in certain sandstone formations and when care is exercised to avoid producing an excessive amount of sizes, the range of sizes from one-eighth to one-half inch often shows marked concentration obtained by simple screening. The attrition method is, of course, useless in the finer or coarser sizes, but in this range ratios of concentration as high as 10:1 have been obtained on typical ores.

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[4] Duschak, L. H., Improvements in the Metallurgy of Quicksilver: Am. Inst. Min. and Met. Eng., Tech. Pub. No. 264, 1930, p. 18.

In Information Circular 6202 C. W. Davis, of the Bureau of Mines, touches on practical methods for mercury detection and plant-control work. He also describes more accurate or "technical" methods of analysis to supplement the rough methods for the valuation of ores and other products that do not give satisfactory results by the simple methods.

COST OF PRODUCTION

C. N. Schuette, in a report prepared for the Bureau of Mines, states that in 1928 the average content of ore treated in the more modern and more efficiently operated American plants was 5.3 pounds of mercury per ton and that the average operating cost, exclusive of royalties and sundry general expense items, was $71.73 per flask. Costs, of course, vary greatly, according to the grade of the ore. For example, based on the assumption that the average mining and reduction cost is $6 per ton, the cost per flask will be only about $30 with ore yielding 16 pounds, but will rise above $75 with 6-pound ore. When the price is $120 per flask 4-pound ore is about the lowest limit of profitable ore.

In recent years costs in Spain have been estimated to be as high as $68 (£14) per flask; if this figure actually represents present-day conditions, it would certainly appear that operating practice could be improved considerably in view of the high yield of the ore (average 8 per cent, or 160 pounds per short ton).

DOMESTIC PRODUCTION

The production of mercury in the United States in 1929 amounted to 23,682 flasks of 76 pounds each; the calculated value of this production, based upon the average New York quotation during the year, was $2,892,638. The quantity is larger than that for any year since 1918, when domestic mines yielded the equivalent of 32,450 flasks of 76 pounds each. The number of mines contributing to the total output was 63 in 1929, compared with 54 in 1928 and 26 in 1927. The mines producing in 1929 were distributed, by States, as follows: California, 29; Nevada, 19; Oregon, 5; Texas, 4; Washington, 2; Arizona, 3; and Alaska, 1.

California led in quantity of mercury produced in 1929 with an output of 10,139 flasks of 76 pounds. Nevada was second with 4,764 flasks, and Oregon was third with 3,657 flasks. Washington produced 1,397 flasks, and Texas, Arizona, and Alaska together produced 3,725 flasks. In addition, 171 flasks of mercury was produced in Nevada from gold and silver pan-amalgamation tailings. Mercury recovered in this way is considered secondary mercury and is not included in the figures of output for 1929 as it has entered into the statistics of production for some earlier year. In 1928 the production, by States, was as follows: California, 6,977 flasks of 76 pounds; Nevada, 2,867 flasks; Oregon, 3,710 flasks; and Texas, Washington, and Arizona together, 4,316 flasks. In addition, 414 flasks of secondary mercury were recovered from pan-amalgamation tailings in Idaho and Nevada in 1928.

Mercury produced in the United States, 1920–1929

	Producing mines	Flasks of 76 pounds	Value
1920	17	13,216	$1,066,807
1921	11	6,256	300,595
1922	10	6,291	368,348
1923	14	7,833	521,302
1924	13	9,952	692,739
1925	13	9,053	762,616
1926:			
California	7	5,651	526,237
Idaho	1	6	551
Nevada	4	194	18,105
Washington	1	482	44,941
Texas, Alaska, and Arizona	4	1,208	112,489
	17	7,541	702,323
1927:			
California	9	5,672	670,217
Nevada	8	419	49,555
Oregon	3	2,055	242,761
Washington	1	559	65,996
Texas, Alaska, and Arizona	5	2,423	286,253
	26	11,128	1,314,782
1928:			
California	26	6,977	$861,692
Nevada	17	2,867	354,061
Oregon	4	3,710	458,147
Texas, Washington, and Arizona	7	4,316	533,103
	54	17,870	2,207,003
1929:			
California	29	10,139	1,238,428
Nevada	19	4,764	581,899
Oregon	5	3,657	446,684
Washington	2	1,397	170,637
Texas, Arizona, and Alaska	8	3,725	454,990
	63	23,682	2,892,638

MARKETS AND PRICES

In the United States, as elsewhere, the price of mercury is governed by the policy of the Mercurio Europeo, the cartel that has controlled the sale of Spanish and Italian mercury since October 1, 1928. During 1929 sales by this agency were limited to not more than 100,000 flasks, but at first production was not restricted and stocks accumulated rapidly. During 1929, however, the output in Italy was curtailed, and later came an announcement that the Spanish mine would be closed in 1930 for a much longer period than usual. Under the original agreement Italy and Spain were to produce in proportion to the capacities of their respective mines, and the joint sales office was to dispose of the total production at uniform prices. Information as to the possible existence of agreements to restrict production (as a means of reducing stocks) is not available.

In London and Lausanne the price in 1929 remained around £22 a flask; the average of the London quotations was £22 5s. 2d., or practically the same as in 1928. In New York the average for 1929 was $122.15, a decrease of $1.36 a flask as compared with 1928. For lots of fair size the low price for the year was $118 to $119 in January and February, and the high point was $125 to $126 reached in August. During the second half of the year prices were maintained at a little less than this high figure, but toward the end of the year some domestic metal was being offered for quick sale at a little below the prices asked for imported supplies. At the end of the year mercury was quoted at $121 to $122 in New York and at £21 17s. 6d. in London. With the import duty of $19 per flask the London quotation (equivalent to about $106.30) was the higher of the two.

San Francisco has long been the primary market for American mercury, and for many years San Francisco quotations were perhaps more representative of the domestic situation than those covering transactions in New York City, the distributing market not only for imported mercury but also for much of the domestic metal. In the last year or two, however, the San Francisco quotations appearing in the trade journals have represented only retail sales or relatively small wholesale transactions, and for this reason they have actually been higher in many instances than the New York quotation. As freight must be paid on mercury shipped from California mines to eastern markets, the price for transactions of equal magnitude would normally be higher in New York than in San Francisco. With respect to Nevada mines, A. D. Nash, of Reno, states that freight from Lovelock to San Francisco (in less than carload lots) is $1.60 a flask; transfer to ship is 5 cents; freight by water to New York, 55 cents; trucking to warehouse, 5 cents; and insurance and interest in transit, $1. These items, with $2 a flask for brokerage, make a total of $5.25.

Altogether there are scarcely 100 firms in the United States that consume as much as 10 flasks each of mercury annually; by far the bulk of the mercury marketed in this country actually passes through the hands of less than a dozen importers, dealers, and large consumers.

Mercury is quoted on the basis of the standard flask containing 76 pounds net weight. Formerly a 75-pound flask was almost universally employed in the United States, and even now one or two domestic mines ship their product in 75-pound flasks. The European flask contains 76.5 pounds.

In former chapters on mercury in Mineral Resources of the United States production and imports and exports were expressed in terms of 75-pound flasks; in order to conform with present conditions the figures have been converted in the present report to their equivalent in 76-pound flasks.

Prices of domestic mercury at New York, 1925–1929, by months [1]

[Per flask of 76 pounds, except as indicated]

Month	1925 [2]	1926 [2]	1927 [2]	1928	1929	Month	1925 [2]	1926 [2]	1927 [2]	1928	1929
January	$81.60	$87.96	$101.20	$123.62	$119.48	July	$83.08	$90.16	$119.88	$121.26	$121.65
February	79.39	87.58	101.73	121.37	119.82	August	82.32	89.26	119.11	124.50	125.11
March	80.48	88.19	110.26	122.56	121.90	September	81.73	91.43	119.64	128.00	124.54
April	82.33	89.77	123.25	123.74	122.00	October	83.86	97.26	126.20	125.92	124.30
May	81.36	91.37	123.90	123.17	121.15	November	88.25	99.00	127.71	123.00	123.32
June	83.15	91.35	118.10	122.42	120.50	December	90.00	99.51	126.93	122.50	121.95

[1] Engineering and Mining Journal.

[2] Price quoted on 75-pound flask prior to June, 1927.

Average yearly prices of mercury in the United States and the United Kingdom, 1916–1929

[Per flask of 76 pounds, except as indicated]

Year	San Francisco (domestic) [1]	New York [2]	London[1]			Year	San Francisco (domestic) [1]	New York [2]	London [3]		
			£	s.	d.				£	s.	d.
1916 [4]	$125.89	$125.49	17	2	10	1923 [4]	$65.68	$66.50	10	4	9
1917 [4]	105.32	106.30	22	4	3	1924 [4]	68.69	69.76	11	19	8
1918 [4]	117.50	123.47		(5)		1925 [4]	82.67	83.13	13	17	1
1919 [4]	90.29	92.15	20	9	5½	1926 [4]	91.60	91.90	15	13	6
1920 [4]	79.66	81.12	20	14	9	1927	117.61	118.16	21	7	11
1921 [4]	47.42	45.46	11	3	5	1928	[6] 125.34	123.51	22	6	1
1922 [4]	57.78	58.95	11	11	6	1929	[6] 124.00	122.15	22	5	2

[1] Mining and Scientific Press, San Francisco.
[2] Engineering and Mining Journal, New York.
} Eng. and Min. Jour.-Press, 1922–1925; Eng. and Min. Jour., 1926–1929.
[3] Mining Journal (London).
[4] Price quoted on 75-pound flask prior to 1927.
[5] Quoted as "nominal" only.
[6] Beginning Oct. 27, 1928, quotations for San Francisco are on basis of "retail and small wholesale lots."

The quotations for mercurial chemicals were even more stable than those for the metal. Throughout 1929 prices quoted by the Oil, Paint, and Drug Reporter remained unchanged, as follows: Calomel, $2.05 a pound; bisulphate, $1.63; red precipitate, $2.16; white precipitate, $2.24; blue mass (U. S. P.), $1.02; and mercurial ointment (33⅓ per cent), $0.94. These quotations correspond exactly with those reported for 1928. As usual, the prices of vermilion red (English mercury) exhibited more fluctuation, but the range in 1929 was only from $1.85 to $1.90 a pound, as compared with $1.75 to $2 a pound in 1928.

CONSUMPTION AND SUPPLY

Supply of mercury in the United States, 1920–1929

[Flasks of 76 pounds]

Year	Production	Imports for consumption	Exports	Apparent supply
1920	13,216	13,982	1,533	25,665
1921	6,256	10,462	388	16,330
1922	6,291	16,697	287	22,701
1923	7,833	17,836	314	25,355
1924	9,952	12,996	205	22,743
1925	9,053	20,580	201	29,432
1926	7,541	25,634	114	33,061
1927	11,128	19,941	(1)	[2] 30,900
1928	17,870	14,562	(1)	[2] 32,300
1929	23,682	14,917	(1)	[2] 38,500

[1] Not separately classified for 1927, 1928, and 1929.
[2] Estimated by Bureau of Mines.

IMPORTS AND EXPORTS

For the 5-year period 1921 to 1925 imports for consumption constituted more than two-thirds of the apparent domestic new supply, but in 1928 and again in 1929 they were less than the domestic production. In 1929 " general " imports decreased to 14,292 flasks of 76 pounds from 15,378 flasks in 1928 and 24,326 flasks in 1927. Spain is credited with 66 per cent and Italy with only 6 per cent of the total imports in 1929, whereas in 1928 Spain furnished less than 40 per cent and Italy nearly 37 per cent of the imports. There were increases in receipts from some of the other European countries, but there was a sharp decline in Mexican shipments, which dropped from 1,792 flasks in 1928 to 1,209 flasks in 1929. Stocks in bonded warehouse continued to decline but are still above normal; they amounted to 3,593 flasks on December 31, 1929, compared with 5,476 flasks at the end of 1928.

Imports of mercurial compounds are not large; they tended to decline in 1929.

Under the tariff act of 1922 the duty on mercury was 25 cents a pound, or $19 a flask (76 pounds). No change was recommended either by the House or Senate in the tariff bill (H. R. 2667) of 1930. The provision for the free entry of flasks or containers exported empty and returned filled was likewise continued without change. The duties on calomel, corrosive sublimate, and other mercurial preparations were changed from 45 per cent under the act of 1922 to 22 cents a pound plus 25 per cent under the act of 1930 (par. 17). Particularly with respect to calomel, the change was in effect a reduction, even at prices somewhat lower than have prevailed in the last few years. The duty on quicksilver vermilion, on the other hand, was increased from 28 cents to 35 cents a pound (par. 76).

Mercury imported for consumption in the United States, 1920–1929

Year	Pounds	Metric tons	Flasks (76 pounds)	Value
1920	1,062,647	482.01	13,982	$971,510
1921	795,078	360.64	10,462	457,993
1922	1,269,004	575.61	16,697	757,842
1923	1,355,499	614.84	17,836	816,043
1924	987,719	448.02	12,996	566,820
1925	1,564,112	709.47	20,580	1,200,878
1926	1,948,170	883.68	25,634	1,784,250
1927	1,515,535	687.44	19,941	1,780,134
1928	1,106,736	502.01	14,562	1,437,153
1929	1,133,721	514.25	14,917	1,513,197

Mercury imported into the United States, 1926–1929, by countries

[General imports]

Country	1926		1927		1928		1929	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Belgium					68,454	$93,823	94,969	$129,083
Canada	13,310	$11,678			5	10	37,500	52,195
Chile			300	$490				
France							24,587	33,966
Germany	1,670	1,501			40,954	57,414	53,259	70,677
Hong Kong			5	6			3	4
Italy	882,589	830,781	681,653	791,060	428,821	558,622	67,778	90,532
Mexico	80,412	67,609	138,268	161,490	136,208	176,968	91,854	122,229
Netherlands			3,800	4,458				
Peru							960	700
Portugal	59,220	47,466						
Spain	1,058,775	966,368	1,024,742	1,231,991	464,206	643,621	715,311	947,756
Turkey in Europe	12,600	11,178						
United Kingdom	37,500	34,877			30,100	41,559		
	2,146,076	1,971,458	1,848,768	2,189,495	1,168,748	1,572,017	1,086,221	1,447,142

Mercury compounds imported for consumption in the United States, 1928 and 1929

Compound	1928		1929	
	Pounds	Value	Pounds	Value
Chloride (mercurous) (calomel)	5,588	$8,154	2,676	$4,355
Oxide (red precipitate)	2,240	2,663	-------	-------
Mercury preparations (not specially provided for)	18,430	23,990	3,298	6,360
Vermilion reds (containing quicksilver)	96,248	127,752	85,465	111,887
	122,506	162,559	91,439	122,602

Mercury exported from the United States, 1920–1929

Year	Pounds	Metric tons	Flasks (76 pounds)	Value
1920	116,493	52.84	1,533	$129,993
1921	29,501	13.38	388	18,869
1922	21,834	9.90	287	15,910
1923	23,827	10.81	314	25,195
1924	15,581	7.07	205	14,333
1925	15,289	6.93	201	15,930
1926	8,668	3.93	114	10,319
1927–1929	(1)	(1)	(1)	(1)

[1] Not separately classified for 1927, 1928, and 1929.

MINING INDUSTRY BY STATES

CALIFORNIA

Mercury was discovered in the United States first at the New Almaden mine in Santa Clara County in 1824, and year after year California has retained first place in the list of producing States. The famous New Almaden mine was closed in 1926, and other old mines have ceased to be worked. New mines, however, have been discovered and operated so that in 1929 California made greater gains in production than any other State and furnished 43 per cent of the total domestic output, as compared with 39 per cent of the total in 1928. The principal producing mines were the Sulphur Bank in Lake County; La Joya, Knoxville, and Aetna mines in Napa County; New Idria in San Benito County; Oceanic in San Luis Obispo County; and Cloverdale in Sonoma County. The New Almaden may also be included in the list as a result of the work of E. T. Haun who recovered, under lease, considerable mercury from the old furnace dumps which cover approximately five acres. The ore is mined with a power shovel and carried in trucks to a sluice. A hand jig and a 4-tube retort constitute the remainder of the equipment. The lessee also did some prospecting for new ore bodies. Several other mines and properties in the vicinity were active in 1929. The California-Nevada Quicksilver Mining Co. (Otto Taubert, president) started a 300-foot tunnel and is reported to have struck ore on the Tilton Ranch. The Santa Clara Quicksilver Corporation, which started work in November, 1928, on the Piercy property, operated only a short time in 1929.

A recent discovery in southwestern Inyo County is of special interest because it is associated with hot springs, the vapors from which carry mercury in appreciable quantities.[5] In Kern County the Santa Ana Mining Co. remodeled the Cuddeback plant 2 miles from Keene and produced mercury in connection with its development program.

In Lake County the Sulphur Bank mill was operated on dump material, and another flotation mill was operated at the Konocti mine near Lower Lake. J. L. Jago, who is working the latter property, proposed to install a similar plant at the Baker mine in the same district.

The La Joya and Oat Hill mines of the Acme Mines & Mill Co. (Inc.) and the Aetna property, all situated in a serpentine belt across the northern part of Napa County, were active in 1929. The Aetna mine, operated by the Aetna Cinnabar Properties, Consolidated, was refinanced and the equipment, including an 80-ton rotary furnace, was overhauled and put in good working condition. The Acme Co. installed a 100-ton rotary furnace, a Diesel engine, and an electric generator at its Oat Hill mine in 1929. A 40-ton furnace was completed and put into operation at the La Joya mine in November, 1928. New condensing equipment was installed at the Bella Oak mine at Napa, and George E. Gamble operated a 3-foot Gould furnace at the Knoxville mine. At New Idria a modern screening and ore-sorting plant for treating lower grade ores was installed, and the furnace plant at the Florence Mac mine near by was remodeled.

The Oceanic mine in San Luis Obispo County is one of the largest producers of mercury in California. It is said to have employed 45 men in 1929. This property first produced in 1876. It was shut down from 1921 to 1925, inclusive, but has operated steadily since that time. The deposits are in sandstone, and the mine, owned and operated by H. W. Gould & Co. at the end of 1929, is equipped with a 90-ton rotary furnace, to which the ores are delivered over a 1-mile tramway. In Siskiyou County the Great Northern Quicksilver Mines (Inc.) operated the flotation plant and retorted the concentrates. The Ethel Quicksilver Co. had sunk a 50-foot incline by May, had done considerable additional development, and had installed a 12-tube retort 12 miles west of Bodie, in Mono County. At the Reed mine near Knoxville, in Yolo County, which was reopened in 1928, the work of cleaning out the main tunnel continued for a distance of some 700 feet, and signs indicating that the old workings were near were reported. The adit driven 50 years ago is in the footwall of the vein, but samples of opalite from a cave are said to have panned mercury.

IDAHO

The mercury lode deposits in Valley County are being extensively developed, and a little mercury was produced in an experimental plant.

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[5] Warner, Thor, Mercury Deposit in Coso Range, Inyo County, Calif.: Mining in California, Division of Mines, San Francisco, vol. 26, January, 1930, pp. 59–63.

NEVADA

Noteworthy discoveries of mercury were reported in 30 places in 12 counties in Nevada in 1929. Although not fulfilling the expectations of many operators, the increase in production from 2,867 flasks of 76 pounds in 1928 to 4,764 flasks in 1929 yields concrete evidence of the increased activity in mercury mining induced by high prices and recent discoveries, particularly when it is remembered that in as recent a year as 1926 the State produced less than 200 flasks.

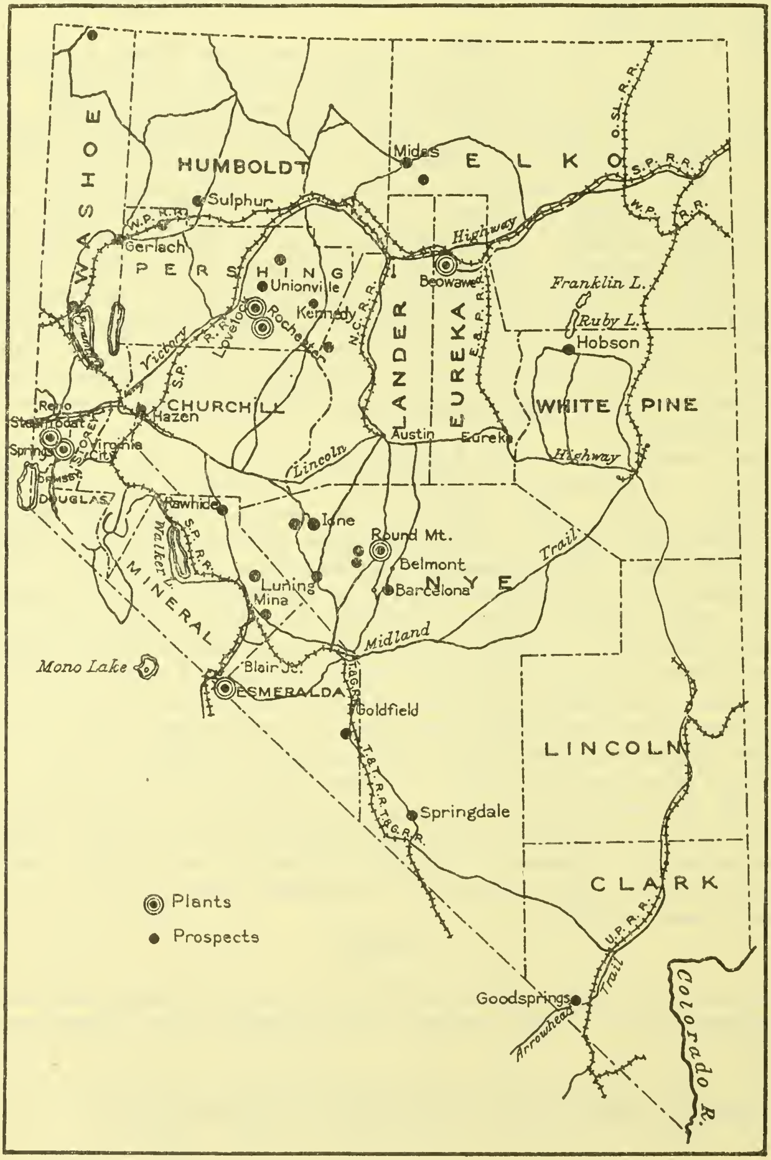
WASHOE
HUMBOLDT
ELKO
Midas
O.S.L.R.R.
S.P. R.R.
W.P. R.R.
Sulphur
W.P. R.R.
Gerlach
PERSHING
Unionville
Kennedy
Lovelock
Rochester
Victory
S.P. R.R.
N.C. R.R.
Highway
Beowawe
Franklin L.
Ruby L.
Hobson
LANDER
EUREKA
E.& P. R.R.
WHITE PINE
Reno
Steamboat Springs
Virginia City
Hazen
CHURCHILL
Austin
Eureka
Highway
Lincoln
Ormsby
DOUGLAS
Rawhide
Walker L.
S.P. R.R.
Ione
Round Mt.
Belmont
Barcelona
NYE
Trail
MINERAL
Luning
Mina
Midland
Mono Lake
Blair Jc.
ESMERALDA
T.&G. R.R.
Goldfield
T.& T. R.R.
T.& G. R.R.
Springdale
LINCOLN
CLARK
U.P. R.R.
Goodsprings
Arrowhead Trail
Colorado R.
Plants
Prospects

FIGURE 1.—Map of Nevada showing mercury prospects and plants

To the 5 rotary furnaces already in the State (1 of which did not operate in 1928) 3 were added in 1929 by H. W. Gould & Co.

The principal producing area is the Antelope Springs district in Pershing County. However, the B. & B. Quicksilver Co. and the Red Rock Quicksilver Co. (Good-McKinney properties) in Esmeralda County, the Castle Peak Quicksilver Co. and the Steamboat Springs Mining Co. in Storey and Washoe Counties, and a number of smaller mines were all active in 1929. A survey of the rapidly growing mercury industry of the State was made in the summer of 1929 for the State bureau of mines by the faculty of the Mackay School of Mines. Figure 1 shows the location of prospects and plants as reported at the time of this survey and in addition a new hot-water deposit 15 miles south of Goldfield, which was omitted from the original map prepared by the engineers of the school.

The chapter of this series for 1928 contained a brief history of the Antelope Springs district, in Pershing County, and a description of the operations of the Nevada Quicksilver Mines (Inc.). In 1929 the company added the Mammoth mine (Montgomery property) and some additional claims to its holdings. There are a number of other mines and prospects, but the only other large producer in this area is the Pershing Quicksilver Co., 23 miles by road east of Lovelock. A part of the ground was first optioned in 1912; 200 flasks of mercury was produced from a retort plant before operations were discontinued. The present operating company took over the property in 1926 and soon blocked out enough ore to warrant the installation of a Diesel power plant and a 4 by 60 foot rotary furnace, which was completed in February, 1928. A few months later, as ore reserves had been considerably increased, the company began the installation of an 8-hearth Nichols Herreshoff roasting furnace to treat the fine ore, thereby eliminating much of the dust trouble and increasing plant capacity nearly fourfold. This operation is further described by the general manager of the company as follows:[6]

> The ore occurs in a prominent sedimentary fault escarpment which runs southeast and northwest for over 2 miles in length at the extreme end of, and at right angles to, the East Humboldt Range of mountains. The limestone of the formation is probably early Jurassic and is intermixed with shale and sandstone beds of varying thickness. Cutting through and roughly paralleling the escarpment are two distinct intrusions. One, intimately associated with the ore, is a diabase, variable in width but traceable by several surface outcrops and the underground workings for over a mile in length along the lode. In places this dike is so thoroughly altered by hydrothermal action as to defy identification, except through characteristic relic crystalline structures visible in thin sections under the microscope. Several hundred feet away in the footwall is a lamprophyre dike, the presence of which seems to have little to do with the genesis of the ore.
>
> The ore is a replacement of a siliceous lime and a black sandstone which underlie a strong sulphidized shale bed dipping about 70° from the horizontal. The ore bodies are not confined within definite walls, but occur in fairly continuous lenses, the boundaries of which are determined by the lowest economic limit at which the ore can be profitably mined. A tremendous fault fissure, in places over 10 feet wide, parallels the dike and ore, and the confinement of the largest lenses to within 40 feet of this break indicates its probable rôle in the genesis of the ore. The richest lenses occur at the intersection of the northeast and southwest cross fractures, which cut the lode at frequent intervals, with the main fissuring. The principal ore mineral is cinna-

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[6] Adamson, W. G., Recent Progress in the Metallurgy of Quicksilver: Eng. and Min. Jour., Sept. 28, 1929, pp. 503–508.

bar, the red sulphide of mercury, and with the exception of a few places near the surface it occurs as the crystalline variety.

Almost all of the development has been carried on in one of four similar hills along the lode, ore being blocked out on three tunnel levels for a distance of 1,200 feet. Up to the present, with the exception of ore from exploratory winzes, all ore mined has come from above the main haulage level, the average distance to the surface from this level being 165 feet. Two 75-foot exploratory winzes have been sunk from this level that show the vein to continue to that depth, at least. Exploratory and development work has recently been started on the two similar hills to the southeast. This work shows the ore and geologic conditions to be about the same in Hill No. 2, whereas in Hill No. 3, which is farther to the southeast, the vein appears to be narrower, but the ore is of a higher average grade. A drift opposite the portal of the main haulage tunnel has just been started to explore the downward extension of a uniform outcrop in the fourth hill to the northwest. * * *

The gases from the Herreshoff furnace are first pulled through a 67-inch cyclone, which exhausts about 72 per cent of the total dust, and then through a 58-inch cyclone, which exhausts about 20 per cent of the total dust, the much finer dust being advanced, accounting for the lower cyclone efficiency compared with the cyclones on the rotary furnace. The cleaned gases are then pulled through 64 8-inch by 8-foot black iron pipes and 32 monel-metal pipes of the same size arranged in 12 rows of 8 each in the same battery. Monel pipes were substituted for the tile pipes in the other unit. A fan driven by a variable-speed motor pulls the gases from the metal cyclones through the condensing pipes and forces them into two small redwood tanks fashioned on the cyclone principle, which are 5 feet in diameter and 10 and 12 feet high, respectively. From these the gases pass into the four 12 by 16 foot redwood settling tanks, a 40-foot wood-stave stack on the last tank, drawing away the residual gases. No water sprays or water-jacketed cooling devices of any description are employed.

Under ordinary conditions the ore passes through the rotary furnace, running at a speed of 72 revolutions an hour, in about 55 minutes. It is dropped into the calcine bin at a cherry heat, the object of the bin being to allow any remaining mercury in the ore to sublimate and to effect a saving in fuel by preheating the combustion air drawn into the furnace. The ore remains in the Herreshoff furnace on the average of 1 hour and 45 minutes. The rotary furnace has a capacity of about 50 tons of the coarser material a day, and the Herreshoff a capacity of about 85 tons of the fine material. Before installation of the Herreshoff, about 35 tons a day was calcined by the rotary furnace. No appreciable difference has been noted in the mercury content per ton of ore treated in each furnace, which result is probably because the mineralization is not confined to cleavage faces and by reason of the variation in the hardness and fracture of the ore from the different stopes. The quantity of sized ore for each furnace is regulated by slight changes in the jaw crusher adjustment and the occasional use of a one-fourth-inch screen.

In practice, the method of handling the dust made by the two furnaces has proved extremely satisfactory. The rotary furnace has shown itself to be inherently more of an offender than the rabble stirred unit from a dust standpoint, but with the former treating coarse ore the only dust resulting is that made by the calcining operation and the abrasive action of the revolving tube. The cyclones on the Herreshoff furnace collect an average of 135 cubic feet of extremely fine dust every 24 hours, 80 per cent of this being arrested in the first cyclone. Carefully metered oil-flow, into both furnaces, indicates a consumption of 7.2 gallons a ton for the rotary furnace and 5.4 gallons for the Herreshoff. A 27° Baumé oil is used for both furnaces and the Diesel engines, and is placed in a 40,000-gallon storage tank at the mine for 8 cents a gallon.

The rotary furnace is equipped with a No. 9 Witt high-pressure burner, which injects the oil and air together at 50-pound pressure. Two No. 90 Mahr triple atomizing burners are kept fired regularly on hearth No. 4 of the Herreshoff furnace (the hearths are numbered from the top down, exclusive of the top or drying hearth), and a smaller burner is kept fired as a "booster" on hearth No. 2. Two burners are installed on hearth No. 6 but are used only in heating up the furnace. The Herreshoff furnace is equipped with a recording pyrometer, which indicates the temperatures on hearths Nos. 4 and 6 and of the gases entering and escaping from the cyclones. Average temperature on hearth No. 4 is 1,300° F. and on hearth No. 6 is 1,000° F. Gases entering the cyclones have a temperature of 470° F. and on leaving them a temperature of 450° F. A recording pyrometer on the rotary furnace indicates the temperature of the gases entering the condensing pipes, which is about 470° F.

The iron condensing units of each furnace are cleaned every other day and the tile condensers of the rotary furnace once a week. When cleaning the condensers the speed of the fan between the pipes and the redwood tanks is increased, and the iron doors on the cement receiving chambers are opened. The free mercury runs into a concrete launder, which has an outlet into one of two submerged cast-iron pots having a capacity of 100 flasks each. The "soot" is removed by a scraper and hoed in a metal-lined box, no lime being added to assist in the extraction. The residue, which amounts to a quantity sufficient to fill two wheelbarrows daily, is dumped at intervals onto the conveyor belt leading to the Herreshoff furnace.

Increased efficiency of the dust arresters in the plant has minimized the effectiveness of the large settling tanks, and their rôle in the saving of the "quick" is a doubtful one, 60 days' operations resulting in the saving of less than 200 pounds of a low-grade "soot." Assays on the regularly burned calcine from both furnaces show a trace of mercury, and the stack loss is practically nil.

The mill crew consists of a furnace man and a man to operate the crusher and drag line on each shift. In addition, on the day shift a "soot" man, a repair man, and a furnace foreman are employed. In the average mine operations two machines are employed on mining and three on development work. A crew of three men tram the ore in 1-ton cars to the mill.

The camp consists of two bunk houses and other structures capable of housing more than 40 men, office and superintendent's quarters, and a cook house with refrigeration chamber and an eating room. Water is scarce in the region and a serious shortage is threatening, but sufficient for ordinary needs has been piped in a 1¾-inch line from Antelope Springs, nearly 2 miles away.

G. H. Jones, of Chicago, is president of the company; W. G. Adamson is vice president and general manager; J. H. Hartley, superintendent; and A. Livingstone, secretary-treasurer.

The B. & B. Quicksilver Co., which in 1927 purchased property in the Fish Valley district in western Esmeralda County, in 1929 added to its old equipment a 5 by 50 foot rotary furnace and steam plant, an air compressor, and a 4 by 60 foot rotary furnace for dusting precipitate ore and cast-iron compressor. An 80-hp. Diesel engine and electric generator were also installed, and in January, 1930, the steam plant was abandoned. The combined capacity of the old furnace (60 tons) and the new one (80 tons) is 140 tons of ore daily, equivalent to an estimated production of 300 to 350 flasks of mercury monthly. Manager Bumsted is credited with the statement that ore reserves are ample to supply both furnaces for five or six years. Ore has been opened to a height of 40 feet in one raise and 60 feet in another raise. About one-fourth of the exploited deposit is a volcanic sinter containing about 30 pounds of mercury per ton and the remainder of the ore is opalite, which brings down the general average of the ore treated to between 5 and 6 pounds per ton. The ore body outcrops along the slope of the hill on two sides with no overburden to be removed. The Red Rock Quicksilver Co., also in Esmeralda County, was operating four claims including the Good-McKinney property. The ore, which is high grade, is treated in a small rotary (16 tons) and two retorts. The Nevada Cinnabar Mines (Inc.) (J. P. Sweeney) is said to have opened up a promising show in the Montezuma district, Esmeralda County, 19 miles from Goldfield, but prospecting on claims near Fish Lake was evidently disappointing as the World Exploration Co. surrendered its options after a few months' work.

In Churchill and Douglas Counties cinnabar has been found associated with gold. In Elko County the Newhall interests are reported to have purchased from F. R. Bowers the Invanhoe group of claims, including the Mayflower and Wild Horse mines, 14 miles southeast of Midas. A new rotary furnace patented by Mr. Andrews, chief engineer of the company, was expected to begin operation early in 1930.

In Mineral County the year 1929 witnessed many new activities. Only assessment work was done at the Drew (Drew-Bugg) mine. This is one of the oldest mines in the district and is situated on the western side of Cinnabar Mountain, 14 miles east of Mina; it has been practically idle since the death of Al Drew five years ago. The Mina Mercury Co.'s mine on the eastern side of Cinnabar Mountain was bonded in April to Miller & Gunnell, who placed a 30-ton rotary furnace on the property but did not complete construction of the plant before the end of the year. E. W. Bedford, manager, has estimated that 35,000 tons of 0.7 per cent ore has been blocked out. During the war a number of shipments of 9.5 per cent ore were made from this property. The Tonopah Hasbrouck ground on the south branch of Dunlap Canyon, 4 or 5 miles south of Cinnabar Mountain, was prospected; an air compressor was installed for driving a tunnel 125 feet below the outcrops. Property on the opposite side of the ridge was optioned for a time to E. A. Montgomery and later to W. T. Childers and William Rudolph. In the interim a little ore from this property was treated in a retort on an adjoining property. The Kane property, known as the Reward group, was leased early in the year to Glen B. Mills; after building a D retort and producing at the rate of approximately 10 flasks of mercury monthly between July and October, he turned over his lease and bond to H. H. Leighton, who started two tunnels and produced a small amount of mercury in connection with prospecting and development work. The Cornelius-Mace property, near the lower end of Dunlap Canyon, was taken over during the latter part of the year by the Mammoth Quicksilver Co.; the company has added to the original purchase (the Easter group), acquiring in all some 11 locations extending south to the Hitt property. Prospecting is said to have disclosed three separate ore bodies. The company is making extensive preparations to develop the formation, which appears to be a fractured zone of limestone, shale, and sandstone more or less highly mineralized. Specimens of ore containing as much as 40 per cent of mercury have been found, and 2.5 per cent ore has been produced and treated in the retort. Towner & Ott are said to have made a strike late in the year on ground adjoining the Drew mine. Inman Bros. were prospecting the Crystal Quick mine, 16 miles southeast of Mina, and Chris Smith reported the discovery of cinnabar, assaying 0.5 to 3 per cent of mercury and also carrying gold and silver values, at the Cinnabar King property, 4 miles south of Luning, in the Gold Range district.

Other developments include the operations in Eureka County of the Nevada Mexican Mining Corporation, formerly Nevada Combination Mines, which started production in the spring with a 40-ton rotary furnace at its property three-quarters of a mile from Beowawe. The Steamboat Springs Mining Co., Washoe County, also began production in 1929. A large tonnage of ore is said to have been blocked out; as the ore is low grade it is first concentrated by flotation and then treated in an 8-tube Johnson-McKay retort. In Humboldt County the Minerals & Metals Corporation is said to have found ore. Considerable activity was reported in Nye County. Indian prospectors located claims in White Pine County for George Southworth, of Reno, and F. M. Crosby, of Wadsworth, who later surrendered the property because of the low grade of the ore.

OREGON

At the Black Butte mine the Quicksilver Syndicate operated two rotary furnaces; the Opalite property, described in the chapter of this series for 1927, was also a producer. The Oregon Mercury Co. (Inc.) discontinued work at the Farmer property in Douglas County on account of low grade of ore. The Bonanza mine near Sutherlin, Douglas County, was not operated during the year but, litigation between the owners having been settled, was expected to open up in 1930. No production was reported from the Elkhead mine, also in Douglas County. The mine at Prineville in Crook County, which was operated during the year, was sold to the Cinnabar Mines (Inc.) in December. A new retort has been installed to treat ore produced in the course of development and exploration work. Mines in Jackson County reported no production. The Big Boy group of claims on the Oregon-California State line between Curry County, Oreg., and Del Norte County, Calif., was equipped with a pipe and giant preparatory to hydraulicking. The mercury minerals, cinnabar and metacinnabarite, are carried in a disintegrated dike and are said to be readily recovered in sluice boxes; the yield was more than 2 pounds of mercury to the yard. The property is expected to begin production in March, 1930.

TEXAS

Production was relatively stationary in Texas in 1929, the Chisos mine continuing as the principal producer. The Waldron properties which ceased production in August, 1927, partly as a result of lawsuits, produced a little ore in 1929 but did not operate their Scott furnace. F. W. Oakes, jr., abandoned the "39" mine, and the rotary furnace was moved to the property of the Brewster Quicksilver Consolidated. Operation of the Scott furnace at the latter property was discontinued late in the year, and the 30-ton rotary furnace was made ready to start up in January, 1930. Retorts at the Rainbow mine were operated during the year. All these mines are in the Terlingua district, which was described in the chapter of this series for 1927.

WASHINGTON

The Barnum McDonell Mercury Co. and the Morton Cinnabar Co. (Fisher Mercury Mining Co.), both in Lewis County, produced mercury in 1929. The former company was superseded in June by the Consolidated Mercury Mining Co. (F. B. Prescott, president), which immediately proceeded to construct a Herreshoff furnace. The Morton Cinnabar Co. undertook driving a 1,500-foot tunnel to tap the veins 300 feet below the old workings; it has a 30-ton rotary furnace.

WYOMING

Several of the western mining papers have contained frequent references to a large area, some 300 miles in length and 8 to 40 miles in width, said to contain a well-defined low-grade deposit of native mercury in the form of minute globules distributed through the alluvials. In one district north of Lysite it was said that one-half pound or more of mercury had actually been recovered by ordinary sluicing; in addition, the gravels were reported to contain gold ranging in value from a few cents to $2 a yard. John G. Marzel, State geologist, examined the area but was unable to confirm the occurrence.

WORLD PRODUCTION

World production of mercury, 1925–1929, by countries

[Compiled by L. M. Jones, of the Bureau of Mines]

[1 metric ton=29.008 flasks of 76 pounds]

Country	1925		1926		1927		1928		1929	
	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons
Algeria	55	1.9	75	2.6	29	1.0			122	4.2
Austria	168	5.8	171	5.9	160	5.5	133	4.6	113	3.9
Bolivia [1]							46	1.6	49	1.7
Canada			6	.2						
China	[1] 95	[1] 3.3	[1] 58	[1] 2.0	[2] 2,147	[2] 74.0	(3)	(3)	(3)	(3)
Czechoslovakia	2,129	73.4	2,387	82.3	1,601	55.2	2,086	71.9	1,897	65.4
Italy	53,189	1,833.6	54,274	1,871.0	57,900	1,996.0	57,677	1,988.3	53,810	1,855.0
Japan							14	.5	(3)	(3)
Mexico	1,123	38.7	1,317	45.4	2,353	81.1	2,535	87.4	2,390	82.4
New Zealand					20	.7				
Rumania	95	3.3	58	2.0	104	3.6				
Russia [4]	287	9.9	3,678	126.8	2,147	74.0	2,950	101.7	(3)	(3)
Spain	37,052	1,277.3	46,244	1,594.2	72,316	2,493.0	63,675	2,195.1	(3)	(3)
Turkey	98	3.4	160	5.5			87	3.0	235	8.1
United States	9,053	312.1	7,541	260.0	11,128	383.6	17,870	616.0	23,682	816.4
	103,344	3,562.7	115,969	3,997.9	149,905	5,167.7	147,073	5,070.1	(3)	(3)

[1] Exports.
[2] Production as reported by Geological Survey of China.
[3] Data not available.
[4] Year ended Sept. 30.

The mercury resources of the world are summarized by Wehrly as follows:[7]

> Although many countries have worked ore deposits for mercury, the two determining factors of successful operation—continuity of the ore body and tenor of the ore—have economically resolved the producing centers into Spain, Italy, and the United States. These countries for the past 10 years (and even prior to that when consideration is given to the production of Austria, which in 1919 was granted to Italy) have accounted for over 90 per cent of the world's output of the metal.
>
> * * * although throughout the entire world we find records of mercury, political, economic, and geographic reasons still permit Spain (and by her leave—Italy) to dominate the production and dictate the price of this metal in the markets of the world.

After reviewing the industries in the three principal producing countries and Mexico, the same author describes conditions in other parts of the world as follows:

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[7] Wehrly, Charles S., Mercury Resources: Chemical Markets, vol. 26, No. 5, May, 1930, pp. 482–484.

In South America mercury has been found in the Argentine, Bolivia, Brazil, Colombia, Ecuador, Paraguay, Uruguay, and Venezuela, but it is only in Peru and Chile that production of any volume has been recorded. In the Province of Coquimbo in Chile ore containing 0.40 per cent has been treated, but since 1922 no record of further production is found, and it is assumed that the workings have been abandoned.

In the year 1566 operations at the Santa Barbara mine in the department of Huancavelica, Peru, were started, and it is stated that up to 1839, when active working of the property was discontinued, approximately a million and a half flasks of mercury had been produced.

An attempt was made in 1915 to reopen this mine, but in 1926, after a large expenditure of time and money, the owner decided that the property was exhausted. It is interesting to note that the Department of Commerce of the United States reported an importation of four flasks from Peru in 1927, but, as a matter of fact, these were flasks exported from the United States and returned.

It has been reported that mercury was produced in the Kuskokwim district in Alaska from deposits discovered in 1884, but it is unlikely that the country will become a factor. Portugal and France have deposits, but unlike Germany, where mines in the Bavarian Pfalz, now exhausted, were worked as early as the thirteenth century, they have not been found to be of any commercial value. Austria now produces but a small quantity as a by-product, and in losing the Idria mine lost its prominence in the mercury field.

We find reference to the workings of the Mount Avala mine in Serbia from 1889 to 1895, but apparently the deposit was too small or the ore too lean, as no further metal is listed as coming from that country. In Turkey the Kara-Burnu mine produced from 0.33 per cent ore a maximum of 3,000 flasks annually, but this production, owing to political circumstances, has ceased.

The Nikitoff mine, in the Donetz Basin in Russia, was responsible for an output of over 1,000 flasks in 1923, but records available show this production of late years to have been greatly curtailed. The extent of the ore body is not definitely known, and it is doubted that the mine will ever be of great economic importance.

Throughout the Transvaal, in Abyssinia, Madagascar, and in Algeria there are records of cinnabar deposits, but in none of these countries has production been upon a commercial scale. In Sumatra and Java there are likewise deposits, but only in Borneo is there any record of production, and this from a mine which has apparently been abandoned. Beautiful specimens of cinnabar have come from the East Indies, but the ore bodies are of such small extent that it would not pay to work them.

To encourage production at the New Zealand Quicksilver Co.'s mine in the Puhipuhi district the Government offered a bonus for the first 100,000 pounds produced. Ore bodies which in 1922 were stated to have been opened up to the extent of 60,000 tons of 1 per cent ore had produced up to 1920 a total of 395 flasks. No record is available for 1921, but 1922 showed a total of only 21 flasks, and no further reports up to 1926 have been made. The character of the ore is such as to make furnacing difficult, and the Thornhill wet process was proposed but with no appreciable success.

In Australia there are records of deposits along the Queensland coastal range but these, along with those reported in New South Wales, have not so far been producers. In 1922 came the reported discovery of a vein of mercury-bearing ore 7 miles long and 6 feet wide near the village of Kita Uonome in Japan. It was contended that the ore assayed up to 1 per cent. In 1923 the reported production of Japan was 4 kilos and none has been made since. So rich a deposit as this would surely show some results. In the provinces of Kweichow and Hunan in China 13,816 flasks were produced in 1925. Antiquated methods of mining and treating the ore, political disturbances, and labor troubles all tend to diminish China's output, and that country is still an importer of considerable quantities. There are possibilities in Southern China which might, under proper guidance, change this.

FOREIGN SOURCES

ALGERIA

Rather extensive deposits of mercury exist in the districts of Guelma and Jemmapes, Department of Constantine, in Algeria. Production has been derived largely as a by-product from the smelting of complex ores containing in addition to mercury, lead, zinc, copper, and antimony. Reserves are estimated at 120,000 tons, averaging 4 to 5 kilos of mercury per ton, the content increasing with depth.[8] Oscar S. Heizer, American consul at Algiers, in an unpublished report (Bureau of Mines Foreign Files, No. 8581, p. 27) states that new equipment was being installed at the mine, increasing the capacity to 120 tons of ore a day; as a result a production of 100 tons of mercury metal was anticipated in 1930. The output in 1927 was only 1 metric ton.

AUSTRIA

The Gewerkschaft Schwazer Bergwerksverein, of Schwaz, Tyrol, recently began the production of mercury from ores furnished by its own mines. The plant produces about half a ton of mercury per month and is the only domestic source of supply for this metal.[9]

CANADA

In 1926, as the price of mercury was rising, the mines branch of the Canadian Department of Mines instituted an investigation of possible sources of supply. The only Canadian deposits that have been operated at all extensively are those in British Columbia at Kamloops Lake at Copper Creek Station on the Canadian National Railway about 5 miles east of Savona. The ore zone is about 3 miles wide and contains deposits in irregular fissures traversing volcanic rocks and closely associated with porphyry or rhyolite dikes. Between 1895 and 1897 the Cinnabar Mining Co. produced in this area about 140 flasks of mercury; in 1926 and 1927 the British Quicksilver & Mining Co. reopened some of the old workings and obtained a few tons of hand-sorted ore, producing six flasks of mercury. Most of the material classed as " ore," however, appears to have been too low grade to be worked even under present conditions. The larger part of the metal recovered in the earlier workings came from one pocket. Cinnabar showings have been found in various other parts of British Columbia, including Vancouver Island, where small, scattered pockets of good ore are said to have been found in 1891. Mercury is also reported at Groundhog Lake, northwest of Sudbury, Ontario, although no development has been recorded. Some of the Cobalt silver ores contain small amounts of mercury, apparently in the form of an amalgam with a native silver.

DUTCH GUIANA

According to Charles Palache,[10] for many years dealers supplied mineral collections with unusual and striking specimens of cinnabar in well-rounded pebbles from a vaguely designated locality, Surinam River, Dutch Guiana. D. V. Keedy, Melrose Heights, Mass., more recently supplied a more accurate description of the occurrence. He says that the cinnabar occurs in the Nassau Mountains in the interior of Dutch Guiana, about 75 miles in an air line southeast of Paramaribo, the capital of the colony, but four days' distance by boat or trail. The area where it is found, the Keedy concession, is in the Marowyne district, near the headwaters of the Tempati River. It is reached either by ascending that river through its lower branch, the Commewyne, or by a longer route up the larger Marowyne River, depending upon the season of the year. The cinnabar pebbles, which were first found in the gold placers 20 years ago, caused a search for the primary deposits, and that search has yielded interesting information with reference to their geological nature.[11] Up to the present time the deposit seems to be of academic interest only.

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[8] Quecksilber: Ztschr. prakt. Geol., Jahrg. 37, No. 9, Halle a. S., 1929, p. 114.

[9] Perkins, C. Warwick, American vice consul, Vienna, Austria: Consular Rept., Dec. 19, 1928, Bureau of Mines Foreign Files, No. 2919, p. 6.

[10] Palache, Charles, The Occurrence of Cinnabar in Dutch Guiana: Am. Mineralogist, vol. 12, 1927, pp. 188–189.

FRANCE

Available information with respect to a historic mercury mine in Brittany was summarized several years ago.[12] This mine is situated about 1 kilometer north of the church of the Chapelle-Enjuger and about 10 kilometers west-northwest of Saint-Lo, in the Department of La Manche. It was worked between 1710 and 1715 and has been reopened since at various intervals. As late as 1905 an attempt was made to explore the old workings, but a large flow of water was encountered; later the old stopes apparently caved in. It was reported, however, that four veins of cinnabar were uncovered and that some of the ore carried not less than 1½ or 2 per cent of mercury, a higher mercury content than that carried by many ores now worked profitably in the United States and in other parts of the world.

GERMANY

During the second half of the eighteenth century mines in the northern section of the Rheinpfalz, in Bavaria, about 40 to 50 kilometers south by southwest from Bingen, supplied most of the mercury used in northern Europe. Interest in these long-abandoned mines was renewed in 1927, when organization of the Spanish-Italian sales cartel was being considered. There was evidence that certain of the deposits, at least, had not been exhausted, but no important efforts to resume mercury mining in Germany have been reported.

ITALY

In 1929 Italy produced 1,855 metric tons of mercury, compared with 1,988.3 tons in 1928. The principal producing districts are the Monte Amiata and the Idria. The former, in Tuscany, midway between Florence and Rome, includes six major mines and numerous smaller ones and is the larger of the two districts. The Idria mine, acquired by Italy from Austria by the Treaty of Rapallo on November 12, 1920, is about 28 miles northeast of Trieste. It was first worked in 1470, and its ownership alternated between the

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[11] Palache, Charles, work cited.

[12] Baudre, G., Monographie de la Mine de Cinabre de la Chapelle-Enjuger: Bull. de la Société Géologique et Minéralogique de Bretagne, vol. 7, Nos. 1 and 2, Rennes, 1926, pp. 80–134.

Venetian Republic and Austria until 1580, when it became the property of the Austrian Crown and so remained until after the World War. The leading mines in both districts are now controlled by the Italian Government through the Banca Commerciale. These mines and also the privately owned producing properties are now included in the cartel; the organizations specifically mentioned are the Azienda Erarialo di Idria, the Monte Amiata S. A. M., the Società Mercurifera Italiana, and the Stabilimento Minerario del Siele.

The principal mines have been described frequently; the following translation (digest) of a recent description[13] of the new mercury deposits being worked during the last few years by the Società Mercurifera Italiana may be of interest:

> The deposits lie largely to the southwest of Monte Amiata, in the chain of hills that include Monte Labbro and the Banditella. The calcareous formation is of Eocene and Cretaceous ages and conforms to an artificial fold, the axis of which runs north-northwest to south-southeast. It is composed mainly of nummulitic limestone and schists. Work was started in 1919 on the western slope of the Banditella in a basin at an elevation of 900 meters. In this area sulphurous gases and carbon dioxide were given off from approximately 30 fissures (putizze). The main tunnel here, after being driven about 200 meters, struck a well-defined fault running northwest-southeast. Development work in the clay schists and gouge along this fault has opened up over 300,000 tons of ore, containing 0.4 per cent mercury, and it is confidently predicted that the grade will improve along the contact between the siliceous schists (*stanite*) and the limestone. A considerable part of this ore can be worked by open cut.
>
> On the opposite (eastern) slope of the Banditella is the Anteie deposit. On this property a tunnel 1,300 meters long (of which 500 meters had been opened up in 1928) is being driven to connect with the main tunnel from the western slope, so that the two willl form a single mine opening through the Anteie, which is along the route of the cableway connecting the two mines with the metallurgical plants. This tunnel, passing first through nummulitic limestone and later through impregnations of clay, is designed mainly for drainage and ventilation purposes and as a manway and haulage road.
>
> The third development, that of Bagnore, on the western slope of Monte Amiata, was started under a vast outcrop of metamorphosed trachyte impregnated with cinnabar, near the contact between the trachyte and the schists. The importance of this deposit, both because of its mercury content and also because of its position with respect to means of communication and centers of population, is now assured.
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> It is here at Bagnore also that the company's metallurgical plant was established, the cost of transport by cableway from the Anteie and Banditella mines (about 5 kilometers) being largely compensated by certain economic advantages, such as ease in obtaining fuel (naphtha) for the furnaces and nearness to building materials. The plant is constructed of hewn stone and comprises:
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> 1. A 15-ton Spirek furnace, in operation since 1924.
> 2. A 30-ton Spirek furnace, in operation since 1927.
> 3. Three Monaci shaft furnaces for crushed ore and capable together of treating 70 to 80 tons per day.
> 4. Additional necessary equipment, including a drying system, an extractor for purifying the mercury from the products of combustion, and a laboratory.
>
> The ore is treated by the common method of roasting with an excess of air. The yield is said to be very satisfactory. For each 50 tons of ore treated per day, containing 0.3 per cent mercury (which is below the normal), 150 kilograms of the metal is obtained, corresponding to 130 flasks per month. Costs in 1928 were given as not more than 1,200 lire per flask, and the sale price was 1,890 lire.

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[13] Vanni, Manfredo, Le miniere mercurifere del Monte Labbro e delle Bagnore in Toscana: Bollettino della Reale Società Geografica Italiana, vol. 5, Nos. 5–6, Rome, 1928, pp. 295–304.

JAPAN

According to Furness,[14] little is known of the reserves of mercury in Japan. In recent years the only productive mine was the Suigin, in the Prefecture of Awa, on the island of Shikoku, although occurrences are known on the island of Hirado and in the vicinity of Sendai, in the Province of Rikuzen. H. W. Gould & Co., San Francisco, Calif., reported that it was installing a 2 by 24 foot rotary furnace at the plant of the Yamato Suiginzan Kogyosho at Osawa, Shibuyacho, near Tokyo, Japan. Takiyi Mori is the manager of the plant. A detrital deposit of cinnabar was reported[15] near Otomari. Thick accumulations of "scree" are distributed on the southern and the western foot of a prominent hill; the screes consist of débris of Paleozoic quartzite mixed with gravel and sand holding cinnabar, chromite, magnetite, zircon, and garnet. The primary deposit has not yet been discovered.

MEXICO

Despite the maintenance of high prices, the Mexican output declined slightly in 1929, when 82.4 metric tons was produced, compared with 87.4 tons in 1928 and 81.1 tons in 1927. The figures for these years are substantially higher than those for the period 1921 to 1926, when the output ranged from 37 to 46 tons annually, most of which came from the treatment of patio or pan-amalgamation tailings at old silver mines. From 1896 to 1920, inclusive, Mexico produced an average of 173 tons a year. According to Segura,[16] the deposits of mercury in Mexico follow general directions—one along the Sierra Madre Occidental, from the State of Sonora to the State of Oaxaca, and another from northeast to southwest, crossing the States of San Luis Potosí, Querétaro, Mexico, Michoacán, Guanajuato, and Guerrero. In the latter section the most important beds of the country—those of Huitzuco, State of Guerrero, and Guadalcázar, State of San Louis Potosí—are localized. The deposits of Guadalcázar are the most important in the country because they have furnished an enormous quantity of mercury and have been exploited with success in different epochs.

During 1929 the Cia. Minera National Quicksilver S. A. installed a 3 by 40 foot Gould rotary furnace at San Miguel, Chihuahua. The deposit was discovered in 1928; an artesian water supply has since been developed, and now 100 men are required for regular operations. Improved equipment was added at a cinnabar deposit near Otinapi, Durango, and H. W. Gould & Co. furnished a Monel exhauster and dust precipitator to the Mexican Corporation, near Iguala, Guerrero. Iguala is the nearest station to the Huahuaxtla mine in the municipality of Taxco, district of Alarcon, State of Guerrero; this mine was responsible in 1927 for increasing the production by 78.7 per cent as compared with 1926. The following notes are abstracted from an article published in the official Boletin Minero of Mexico.[17]

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[14] Furness, J. W., The Marketing of Mercury: U. S. Bureau of For. and Dom. Commerce, Trade Information Bull. 631, 1929, pp. 9–10.

[15] Ohashi, Ryôichi, Quicksilver Deposit of Otomari district, Japanese Sakhalin (Japanese): Jour. Geog., vol. 40, Tokyo, 1928, pp. 247–250.

[16] Segura, David, El Mercurio en Mexico: Bol. Min., vol. 26, No. 1, Mexico, July, 1928, pp. 16–49.

[17] Boletin Minero, El Mineral de Huahuaxtla, Guerrero (The Mining District of Huahuaxtla, Guerrero): Vol. 24, 1927, pp. 10–16.

The topography of the region is very rough, but suitable road transportation can be provided. Water is abundant only in the rainy season. There is little or no timber of any size, although wood fuel is obtainable. A sufficient labor supply is obtainable locally and it is apparently cheap. Before the introduction of mining labor the inhabitants of Huahuaxtla were engaged in agriculture and in the manufacture of baskets, an industry that yielded a man only about $1.25 a week. Exploitation of the deposit was begun in November, 1925, but was hindered at first for various reasons, including the difficulty of getting adequate fuel. The deposits are scattered over a wide zone and occur in limestone, the ore generally following the stratification. Iron oxide and bituminous material as well as limestone accompany the mercury minerals—chiefly cinnabar with a small quantity of native mercury. A 40-meter shaft, La Aurora (in 1927), followed the ore on an incline varying from 10° to 15°, the thickness of the vein varying from almost a knife blade to as much as 2.5 meters, averaging perhaps 80 centimeters. The mercury content was estimated as being from 0.4 to 31.9 per cent, the average being probably not less than 8 per cent. The ore was originally mined by hand and carried in small baskets a distance of 50 meters to a patio, where it was crushed by hand and sorted, if necessary. A better grade ore was treated in crude retorts and the waste was indicated by the fact that salivation and other forms of mercurial poisoning were not uncommon among the employees. The costs in 1927 were estimated at about $1.71 a kilogram delivered at the station at Iguala, leaving a profit of $5.80 a kilogram when mercury is worth $120 a flask.

NEW ZEALAND

The chapter of this series for 1928 reported that a British metallurgist was investigating deposits for the Imperial Chemical Industries (Ltd.) in New Zealand and that the company had purchased property at Ngawha, near Ohaeawai, in the Puhipuhi district, northern part of North Island. Reports for 1929 are that the Kaikohe Development (Ltd.), a company registered in New Zealand with £25,000 of English capital, a subsidiary of the Imperial Chemical Industries (Ltd.), is erecting buildings and plant to treat cinnabar deposits. R. H. Goodwin is manager of the subsidiary company, and William McNeill is engineer.

The plant includes two rotary furnaces. The company at London purchased an exhauster and two dust precipitators from H. W. Gould & Co. for the New Zealand plant, but most of the machinery is being manufactured at Auckland, New Zealand. The ore is in earth rather than in solid rock and therefore needs no crushing. The machinery will be run by an internal-combustion engine, although electricity will be generated for lighting purposes. A dam is being constructed, and bores are being put down to supply water for the works. Housing quarters have been built, foundations made for the machinery, and leveling and road making completed. The estimated cost of the construction is £75,000.

RUSSIA

According to the annual report of the Mineral Resources of the U. S. S. R. for the fiscal year 1926–27, mercury is found only in Daghestan, the Far East (Siberia), Kirghiz Steppes, and the Ukraine. The Ukraine, however, is the only division of the country in which production was reported. During the year 1926–27 the Ukraine produced 24,799 metric tons of ore and 74.04 metric tons of smelter product from the Nikitov (Nikitovka) mine, in the Donetz coal basin, Government of Ekaterinoslav. The 5-year development plan of the Soviets involves opening up by 1931 or 1932 a mercury mine at Nikitovka in the Ukraine at an estimated cost of 6,000,000 rubles.

SPAIN

Prior to 1920 Spain had long been the largest single producer of mercury in the world. The history of the industry in that country, descriptions of the mines, the yearly offering of the products to the highest bidders, and the part Spain has taken in determining recent world prices, especially through the agreement with Italy, have all been discussed in previous chapters of this series. Probably the most important development in 1929 was the consummation on February 1 of the plan to do away with all manual labor in the mine at Almaden, which contributes approximately 98 per cent of the output of the country.

Under State management labor had imposed many regulations that tended toward inefficiency and decreased output. The equipment generally was antiquated and even the old Bustamente furnaces, built in 1646, were still in use. The Council of Administration assumed control of the mine in 1918 and after its reorganization in 1923 determined to adopt new methods of exploitation and to modernize the equipment. Hitherto the workers had always opposed any innovation that might take away their means of livelihood (the village of Almaden is purely a mining colony), and difficulties were soon encountered. For example, No. 13 level when first exploited with mechanical drilling operations failed for a few months to produce as much as it had when manual labor was employed. Gradually, however, conditions improved, and even for the first year, 1924–25, the output increased from 33,646 flasks in 1923–24 to 35,705; it continued to increase—46,701 in 1925–26, 53,556 in 1926–27, and 75,000 in 1927–28. The average yield under State management had been about 30,688 flasks.

The following description of the new equipment is quoted from the Engineering and Mining Journal of December 14, 1929, pages 922–923:

> *Compressor plant.*—The compressor installed in 1924 is driven direct by a 225-horsepower synchronous motor. The compressor put into service in 1927 is belt driven by a 250-horsepower electric motor. Compressed air generated first passes into two interconnected air reservoirs, each holding 353 cubic feet, and from these it goes through a 6-inch main through the San Teodoro main shaft to level No. 13, where a distributing reservoir is installed. From this reservoir the air passes into the distributing network after the water and oil deposited in it have been removed.
>
> *Drilling operations.*—These are being carried on exclusively with two types of Flottmann hammer drills, which replace all other types. The NW (AN) 65-hammer drill, weighing about 59½ pounds and mounted on a column, is used for drifting, whereas the Type UWV (DU) hammer drilling machine with pneumatic feed (weight, 101 pounds) is used at the face. Of the former type, 33 are at present being used; of the latter, 12 are in use. Work is carried on at 15 points. Two hammers are allotted to each gang, one hammer for working and the other undergoing cleaning, oiling, or repairs. On each shift all gangs take with them into the pit a hammer that has been overhauled and is in proper working order. Two hammers of each type are provided in the pit as spares for use if unforeseen trouble should occur with the regular hammers, which rarely happens. Mechanics are available in the pit for looking after the air-distributing system and to give assistance if difficulty should be experienced with drilling operations.

Repair shop.—A workshop above ground is specially equipped and staffed to keep the hammer drills in working order. Hammers in use the day before are cleaned, lubricated, and, where necessary, repaired in this shop. Air meters are also installed there, to which each hammer is connected daily, so that each machine is subjected to an accurate test, and full and interesting data are available at any time as to the state and performance of each unit. A careful account as to the working and repair costs of each hammer is kept daily to enable its performance in terms of cost to be verified.

Drill forge.—Two sharpening machines are installed in this shop—one American and one Flottmann sharpening machine recently put into service. Both are in use and fully meet requirements. The mine management is satisfied with results, and the praise accorded by the Minister of Industry is proof that the right method and measures have been adopted.

Mercury produced in Spain, 1927 and 1928

Province	Number of mines	Workmen		Ore mined		Metal produced		
		At mines	At plants	Metric tons	Tenor (per cent)	Flasks (76 pounds)	Value [1]	Flasks per man
1927								
Ciudad Real	1	756	336	50, 120	5. 73	72, 023	$4,637,996	65. 96
Granada	3	18	15	1, 233	. 95	293	20, 615	8. 88
	4	774	351	51, 353	5. 62	72, 316	4, 658, 611	64. 28
1928								
Ciudad Real	1	756	336	46, 832	5. 73	63, 397	3, 971, 250	58. 06
Granada	3	30	21	1, 675	. 95	278	25, 385	5. 25
	4	786	357	48, 507	5. 56	63, 675	3, 996, 635	55. 71

[1] Exchange rate of peseta: 1927, 17.0592 cents; 1928, 16.5942 cents.

TURKEY

The Karbausan mine in Asia Minor continues to operate on a small scale.[18]

YUGOSLAVIA [19]

A Polish group is reported to have begun producing mercury in the Bogojno district of Yugoslavia. Two chamber ovens have been put into operation, 8 tons of ore being worked up daily. It is hoped to bring others into operation in the near future.

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[18] Gould, H. W., Quicksilver: Eng. and Min. Jour., vol. 129, No. 3, Feb. 8, 1930, p. 124.

[19] Chemical Age, vol. 22, No. 551, London, Jan. 18, 1930, p. 54.

SILVER, COPPER, LEAD, AND ZINC IN THE CENTRAL STATES[1]

(MINE REPORT)

By J. P. Dunlop and H. M. Meyer

INTRODUCTION

The silver, copper, lead, and zinc mines of the Central States are in Arkansas, Illinois, Kansas, Kentucky, Michigan, Missouri, Oklahoma, and Wisconsin. The territory thus embraced lies in the great interior valley province of the United States, which extends from the Appalachian system to the Rocky Mountain front, exclusive of the Black Hills. Most of the mines are in the Paleozoic sedimentary rocks of this province, but the copper range of northern Michigan comprises lavas and intercalated sediments of pre-Cambrian age.

In the lead and zinc regions of the Central States the material sold is mainly concentrates,[2] and payment is made according to a basic price for concentrates of a certain quality. The details of this method are given in the pages devoted to Missouri in the report of this series for 1914. The figures reported by producers represent the quantity and assay contents of concentrates sold and the amount received in payment. The total metal produced is calculated from the first two of these items.

The operators in Michigan report the quantity of concentrates produced and the actual recovery of copper from concentrates smelted. In any year the mines may produce more or less concentrates than are smelted during the same period. The copper content of concentrates produced but not smelted during the year has been estimated on the basis of the average copper recovery per ton for the year of the company producing it.

TENOR OF ORES OF THE CENTRAL STATES

The only fair basis for comparison of the relative magnitude of mining operations in different States is that of quantity of crude ore or "dirt." There are, however, marked differences in the metal content of the ores of the several mining regions and States, and therefore comparison of tenor of the ores is of interest and significance. All but a very small part of the ore from the Central States is of such tenor that it requires concentration. In Kentucky and southern Illinois most of the lead and zinc concentrates are recovered as by-products in the concentration of the fluorspar that they accompany, and it is not possible to calculate the metal content of the crude ore raised. In Arkansas very little ore has been mined for several years, and the average tenor calculated from the output of ore during these years would not present an accurate comparison with the tenor during a period of active mining.

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[1] Work on manuscript completed August, 1930.

[2] In local usage the ore as mined is called "dirt" and the concentrates are classed as "ore." Where the capacity of a concentrating plant is given, such capacity is to be understood as based on a 10-hour shift unless otherwise stated.

Quantity and tenor of copper, lead, and zinc ores, old tailings, etc., produced in the Central States, 1927–1929, by States

State	1927		1928		1929	
	Ore	Metal content [1]	Ore	Metal content [1]	Ore	Metal content [1]
	Short tons	*Per cent*	*Short tons*	*Per cent*	*Short tons*	*Per cent*
Illinois (northern)	88, 200	0. 82	(2)	(2)	(2)	(2)
Kansas	4, 505, 800	3. 38	4, 662, 200	3. 16	5, 321, 100	2. 98
Michigan	8, 046, 334	1. 10	7, 361, 658	1. 21	7, 598, 180	1. 23
Missouri	6, 824, 000	3. 28	6, 573, 800	3. 26	6, 868, 000	3. 13
Oklahoma	9. 932, 400	2. 89	8, 028, 000	2. 97	9, 324, 600	2. 84
Wisconsin	1, 480, 800	2. 93	733, 500	3. 49	607, 100	3. 79
	30, 877, 534	----------	27, 359, 158	----------	29, 718, 980	----------

[1] The percentages given in this column represent the metal content of the ore in so far as it is recovered in the concentrates. In Michigan the metal so recovered is copper; in the other Central States the metals are lead and zinc, the relative proportions of which are shown in the table on another page and in the tables of tenor of ore given in the sections devoted to the respective States.

[2] No ore milled; concentrates shipped were from ore milled in 1927.

The moderate gain in the quantity of ore and old tailings treated in 1929 in the Central States was shared only by the copper properties in Michigan, the lead properties in southeastern Missouri, and the lead and zinc properties in Kansas and Oklahoma. There was a decreased output of ore from lead and zinc mines in Illinois, Kentucky, and southwestern Missouri. The decrease in the quantity of zinc and zinc-lead ore in Wisconsin was 17 per cent, and although there was a considerable increase in the tenor of the ore milled the resulting concentrates had a smaller zinc content. No lead or zinc ores were mined in Illinois or Kentucky in 1929. Crude ore from Oklahoma milled in 1929 increased about 880,000 tons, and old tailings re-treated increased about 416,000 tons.

The average tenor of ore treated in the Central States in 1929 is best indicated by the average value of the total metal content, which was $3.73 a ton of ore treated. This value was 24 cents more than in 1928 owing largely to the higher average prices of copper, lead, and zinc; however, the quantities of copper, lead, and zinc produced also increased. The 22,120,800 tons of zinc, lead, and lead-zinc ores, old tailings, etc., treated in the Central States, exclusive of the small output of Arkansas, Illinois, and Kentucky, in 1929 yielded lead and zinc concentrates that sold for $54,400,926; consequently, the mine operators realized an average of $2.46 a ton of ore, tailings, etc., mined and treated, compared with $2.47 in 1928. The value of both lead and zinc concentrates was more in 1929 than in 1928. The quantity of lead concentrates marketed was about 10,000 tons and that of zinc concentrates about 20,000 tons. The average value of metals recovered per ton was less because more tailings were treated in 1929 than in 1928. Seven mills in Missouri reported having flotation units; 105,800 tons of galena concentrates and 7,280 tons of sphalerite concentrates were recovered at these mills in 1929 by the flotation process. Forty-six mills in Kansas produced 2,000 tons of galena concentrates and 47,000 tons of sphalerite concentrates by flotation, and 79 mills in Oklahoma recovered 3,200 tons of galena concentrates and 87,000 tons of sphalerite concentrates by flotation.

SUMMARY

The total value of the mine production of silver, copper, lead, and zinc in the Central States in 1929 was $110,979,243, or $15,314,094 more than the value in 1928. The total value from 1907 to 1929 was $2,325,228,359—$916,435,080 for zinc, $735,109,124 for copper, $666,353,538 for lead, and $7,330,617 for silver. The value of the zinc has been much greater than that of the copper for the last 11 years; hence the total value of the zinc during the period is $181,325,956 more than that of the copper.

The value of metal production herein reported has been calculated at the figures given in the table that follows. The silver price for 1920 to 1922 is New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1920	$1. 09	$0. 184	$0. 080	$0. 081	1925	$0. 694	$0. 142	$0. 087	$0. 076
1921	1. 00	. 129	. 045	. 050	1926	. 624	. 140	. 080	. 075
1922	1. 00	. 135	. 055	. 057	1927	. 567	. 131	. 063	. 064
1923	. 82	. 147	. 070	. 068	1928	. 585	. 144	. 058	. 061
1924	. 67	. 131	. 080	. 065	1929	. 533	. 176	. 063	. 066

Mine production of silver, copper, lead, and zinc in the Central States in 1929, by States

State	Silver		Copper		Lead		Zinc		Total value
	Fine ounces	Value	Pounds	Value	Short tons	Value	Short tons	Value	
Arkansas					51	$6, 426	9	$1, 188	$7, 614
Illinois	3, 700	$1, 972			443	55, 818	31	4, 092	61, 882
Kansas					26, 596	3, 351, 096	109, 850	14, 500, 200	17, 851, 296
Kentucky					287	36, 162			36, 162
Michigan	20, 795	11, 084	186, 402, 218	$32, 806, 790					32, 817, 874
Missouri	181, 638	96, 813	2, 240	394	198, 469	25, 007, 094	11, 017	1, 454, 244	26, 558, 545
Oklahoma					46, 513	5, 860, 638	192, 042	25, 349, 544	31, 210, 182
Wisconsin					1, 536	193, 536	16, 986	2, 242, 152	2, 435, 688
	206, 133	109, 869	186, 404, 458	32, 807, 184	273, 895	34, 510, 770	329, 935	43, 551, 420	110, 979, 243
Total, 1928	197, 139	115, 326	178, 507, 704	25, 705, 109	266, 516	30, 915, 856	319, 089	38, 928, 858	95, 665, 149

Silver.—Nearly all of the silver that has been produced in the Central States has been recovered incidentally in the production of other metals. The only silver ore mined in this area in the last 20 years came from Oklahoma. There has been a great decline in the silver produced from the copper lodes of Michigan in recent years and the output in 1929 was only 20,795 ounces. The silver derived from the treatment of lead ore from southeastern Missouri increased 4,798 ounces in 1929. Most of the silver credited to Missouri is now derived from the increasing quantity of zinc concentrates produced from lead ores and not, as formerly, from the refining of lead bullion. The lead-zinc fluorspar deposits of the Kentucky-Illinois field also carry silver, and the silver recovered from the lead concentrates shipped from Illinois in 1929 was 3,700 ounces, an increase of 554 ounces.

Copper.—The mine production of copper in the Central States in 1929, 186,404,458 pounds, was all from Michigan except 2,240 pounds derived from lead-copper matte from Missouri. None of the copper mines in Missouri shipped copper ore in 1929; the copper mines in Michigan increased their output of copper ore 236,522 short tons and their output of copper 7,959,514 pounds.

Lead.—The mine production of lead in the Central States in 1929 increased 3 per cent in quantity and 12 per cent in value. As in 1928 Missouri produced 73 per cent of the total, and the recoverable lead content of galena and lead carbonate concentrates mined in Missouri in 1929 was equivalent to 29.5 per cent of the refined primary lead recovered in the United States from domestic ore during that year. Of the total output of lead in Missouri the disseminated lead district of southeastern Missouri produced 197,435 tons, which was more than the output of any State or other district in the United States. Southwestern Missouri had an output of 1,034 tons of lead, or 89 tons less than in 1928. The production of lead in Oklahoma, as measured by the recoverable metal in concentrates sold or treated, increased from 43,687 tons in 1928 to 46,513 tons in 1929. The shipments from Kansas mines increased from 25,276 tons in 1928 to 26,596 tons in 1929 and that from Wisconsin mines decreased from 1,698 tons in 1928 to 1,536 tons in 1929. Production from Illinois mines increased from 385 tons in 1928 to 443 tons in 1929 and that from Kentucky from 39 to 287 tons. The combined output of lead from mines in Arkansas, Illinois, Kentucky, and Wisconsin amounted to less than 1 per cent of the total output of the Central States.

Zinc.—The mine production of zinc in the Central States in 1929 was equivalent to 54 per cent of the total smelter output of primary slab zinc from domestic ores in the United States. Oklahoma produced 192,042 tons of zinc in 1929, compared with 180,252 tons in 1928. For many years prior to 1918 Missouri was the largest producer of zinc in the United States; in 1929, however, the output was only 11,017 tons, whereas in 1917 it was 132,918 tons. The output of zinc in Kansas, which was 56,225 tons in 1922, was 109,850 tons in 1929; this was 16,457 tons less than in 1926, the year of largest output. In Wisconsin many of the mines were inactive and the output of zinc declined from 18,417 tons in 1928 to 16,986 tons in 1929. The Arkansas output decreased from 86 tons in 1928 to 9 tons in 1929. Kentucky produced no zinc in 1929, and the output of Illinois increased from 17 tons in 1928 to 31 tons in 1929. Iowa has reported no output of lead or zinc for many years.

PRODUCTION OF LEAD AND ZINC BY REGIONS

The productive lead and zinc territory in the Central States naturally falls into seven regions, three of which are not limited to a single State. For statistical purposes the tables showing the production of lead and zinc by States are necessary, but for practical purposes it is desirable to show the production by the natural regions, irrespective of State lines.

The seven regions, in order of size of output, are: (1) The Joplin region, comprising southwestern Missouri, southeastern Kansas, and northeastern Oklahoma; (2) southeastern Missouri, containing the great deposits of disseminated lead; (3) the upper Mississippi Valley region, including all the lead and zinc mines in southwestern Wisconsin, Iowa, and northwestern Illinois; (4) the fluorspar region in southern Illinois and western Kentucky; (5) Arkansas; (6) central Missouri; (7) the Arbuckle Mountain region, in southern Oklahoma.

The southeastern Missouri region produced 72 per cent of the lead output of the Central States and 29 per cent of the primary lead recovered from domestic ore smelted or refined in the United States in 1929. The Joplin region yielded 27 per cent of the lead and 94 per cent of the zinc of the Central States in 1929 and was much the largest producer of zinc in the United States, yielding 51 per cent of the total slab zinc produced from domestic ores in 1929 and 50 per cent of the total in 1928.

The lower zinc content of the zinc concentrates produced at mines in the upper Mississippi Valley region is clearly indicated by the fact that, although these mines yielded 10 per cent of the total output of raw zinc concentrates of all classes, the zinc content of such concentrates was only 5 per cent of the zinc from mines in the Central States.

The lead content of the galena concentrates shipped from the upper Mississippi Valley region averaged about 72.2 per cent, that of the concentrates from the Joplin region averaged about 78.6 per cent, and that of the concentrates from the southeastern Missouri region averaged 72.7 per cent. A very small proportion of the galena shipped from the Joplin region contained more than 82 per cent of lead. A large part of the sphalerite shipped from the Joplin region contained 58 to 60 per cent of zinc, and more than 20,000 tons shipped from the Waco and Smithfield districts in that region averaged 61 per cent.

Mineral Resources for 1914 contains brief reviews of the history of lead and zinc mining in the Central States, the yearly production of each State for the period 1907 to 1914, inclusive, and historical notes and estimates of the total production of lead and zinc in each State before 1907.

Mine production of lead and zinc in the Central States in 1929, by regions

Region	Lead[1]		Zinc[2]		Total value
	Short tons	Value	Short tons	Value	
Concentrates:					
Joplin	96,851	$8,178,548	598,990	$23,546,169	$31,724,717
Southeastern Missouri	277,986	21,017,310	7,031	277,332	21,294,642
Upper Mississippi Valley[3]	2,170	170,588	70,002	1,210,979	1,381,567
Kentucky-southern Illinois	1,164	80,695	---------	---------	80,695
Northern Arkansas	66	5,500	25	605	6,105
	378,237	29,452,641	676,048	25,035,085	54,487,726
Total, 1928	368,881	26,665,976	656,140	22,724,443	49,390,419
Metal:					
Joplin	74,143	9,342,018	309,436	40,845,552	50,187,570
Southeastern Missouri	197,435	24,876,810	3,473	458,436	25,335,246
Upper Mississippi Valley[3]	1,536	193,536	17,017	2,246,244	2,439,780
Kentucky-southern Illinois	730	91,980	---------	---------	91,980
Northern Arkansas	51	6,426	9	1,188	7,614
	273,895	34,510,770	329,935	43,551,420	78,062,190
Total, 1928	266,516	30,915,856	319,089	38,928,858	69,844,714

[1] Includes both galena and a small quantity of lead carbonate concentrates.
[2] Includes sphalerite and a small quantity of zinc carbonate and zinc silicate concentrates.
[3] Includes Iowa, northern Illinois, and Wisconsin.

REVIEW BY STATES AND DISTRICTS

ARKANSAS

By J. P. Dunlop

The value of the lead and zinc from Arkansas mines was $1,430,668 in 1917, but only $7,614 in 1929.

The production of galena in Arkansas is small. The shipments of zinc carbonate and zinc silicate concentrates in 1929—25 tons—were less than 1 per cent of the shipments in 1917.

Mine production of lead and zinc in Arkansas, 1920–1929

Year	Lead concentrates (galena)		Zinc concentrates				Metal content[1]			
			Sphalerite		Silicate and carbonate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1920	10	$755			917	$28,925	8	$1,280	329	$53,298
1921	27	1,510			42	580	21	1,890	15	1,500
1922	55	4,000			425	6,870	42	4,620	134	15,276
1923	32	2,559			444	9,919	25	3,500	148	20,128
1924	25	2,730			13	330	20	3,200	4	520
1925	93	8,546	58	$2,380	44	1,296	58	10,092	43	6,536
1926	28	2,544	8	346	246	7,012	18	2,880	87	13,050
1927	30	2,590			386	9,453	23	2,898	128	16,384
1928	50	4,010			224	5,600	38	4,408	86	10,492
1929	66	5,500			25	605	51	6,426	9	1,188

[1] In calculating the metal content of the ores from assays, allowance has been made for smelting losses of both lead and zinc in 1921 to 1929. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and concentrates produced in Arkansas, 1926–1929

	1926	1927	1928	1929
Total ore short tons	(1)	(1)	(1)	(1)
Average lead content of galena concentrates per cent	64.0	78	76	78.8
Average zinc content of zinc silicate and carbonate do	37.4	38	43	40.2
Average value per ton:				
Galena concentrates	$90.86	$86.33	$80.20	$83.33
Zinc silicate and carbonate	$28.50	$24.49	$25.00	$24.20

(1) The quantity of ore mined was very small, and very little of it was milled, so that no calculations as to tenor are available; part of the ore sold was taken from stock in bins.

The mines are chiefly in Boone and Marion Counties and the adjoining portions of Searcy and Newton Counties, but there are numerous prospects in Baxter, Izard, Sharp, Lawrence, and other counties to the east, and deposits have been worked in Washington and Sevier Counties, on the extreme western border of the State, and in Pike County, in the southwestern part of Arkansas.

The ores are galena, sphalerite, and smithsonite, and the concentrates produced are generally of high grade and free or nearly free from iron or lime. The sphalerite and smithsonite are shown by analysis to contain appreciable quantities of cadmium, especially in a yellow variety of smithsonite known locally as "turkey fat," which shows as much as 0.8 per cent of cadmium. This was the highest content reported for zinc concentrates for the Central States until 1927, when shipments of blende concentrates from southeastern Missouri were reported as assaying 1 per cent of cadmium.

In 1929 only a few of the lead and zinc mines of Arkansas were operated; all work done was spasmodic and no development of importance took place. All of the zinc carbonate concentrates shipped in 1929 were those from stocks held since 1927 by Lon L. Brown, of Zinc; the concentrates came from small mines in Marion County. All of the galena concentrates shipped in 1929 were from the Brewer land near Ponca in Newton County. Most of the ore was mined by the Ponca Mining Co. The mills of the Morning Star and other mines near Rush were idle in 1929. Shipments of lead and zinc ores were made by three operators, and the value of the concentrates decreased from $9,610 in 1928 to $6,105 in 1929.

ILLINOIS

By J. P. Dunlop

Mine production of lead and zinc in Illinois in 1929, by districts [1]

District	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [2]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Northern Illinois			112	$1,962			31	$4,092
Southern Illinois	668	$51,072			443	$55,818		
	668	51,072	112	1,962	443	55,818	31	4,092
Total, 1928	600	44,315	69	824	385	44,660	17	2,074

[1] Mineral Resources for 1914 contains a historical review of lead and zinc mining in Illinois.

[2] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and concentrates produced in Illinois, 1926–1929

	1926	1927	1928	1929
NORTHERN ILLINOIS				
Total ore ... short tons	245,100	88,200	(1)	(2)
Total concentrates in ore:				
Lead ... per cent	0.15	0.12		
Zinc ... do	5.37	3.09		
Metal content of ore:				
Lead ... do	0.11	0.08		
Zinc ... do	1.38	0.74		
Average lead content of galena concentrates ... do	77.9	66.4	78.0	
Average zinc content of sphalerite concentrates ... do	25.6	23.6	27.5	36.0
Average value per ton:				
Galena concentrates	$104.02	$72.74	$76.46	
Sphalerite concentrates	$13.65	$11.27	$11.94	$17.52
SOUTHERN ILLINOIS				
Average lead content of galena concentrates ... per cent	64.2	67.4	65.4	67.7
Average zinc content of sphalerite concentrates ... do				
Average value per ton of galena concentrates	$94.28	$70.23	$73.81	$76.46

[1] Concentrates shipped were milled in 1927. [2] Tailings only treated.

Mine production of silver in southern Illinois, 1920–1929

Year	Silver		Lead concentrates, silver-bearing		Year	Silver		Lead concentrates, silver-bearing	
	Fine ounces	Value	Short tons	Ounces of silver per ton		Fine ounces	Value	Short tons	Ounces of silver per ton
1920	8,193	$8,930	1,252	6.55	1925	3,000	$2,082	797	3.76
1921	1,345	1,345	181	7.43	1926	2,990	1,866	614	4.87
1922	6,025	6,025	1,100	5.48	1927	1,518	861	310	4.90
1923	8,170	6,699	1,762	4.64	1928	3,146	1,840	589	5.34
1924	8,891	5,957	1,678	5.30	1929	3,700	1,972	668	5.54

The value of the mine production of silver, lead, and zinc in Illinois in 1929 was $61,882, compared with $48,574 in 1928.

The lead and zinc deposits of Illinois fall into two distinct regions marked by different mineral associations and structural environment. Those of southern Illinois belong to the Kentucky-Illinois fluorspar district; those of northern Illinois belong to the upper Mississippi Valley region.

NORTHERN ILLINOIS

The lead and zinc mines of northern Illinois are all in Jo Daviess County, the extreme northwestern county of the State. The ores are galena, smithsonite, and sphalerite, although the first two are much less common now than formerly when most of the deposits worked were shallow and above water level.

The entire output of northern Illinois is included under the Galena district, which comprises the mines from the vicinity of Fever River to the Wisconsin State line.

Only one tailing mill was operated in northern Illinois in 1929, no ore was mined, and little prospect drilling was done. The shipments were 112 tons of sphalerite concentrates made by the Hollander tailing mill.

SOUTHERN ILLINOIS

The lead and zinc deposits of southern Illinois are in Pope and Hardin Counties; they occur in rocks of Mississippian age in the northern extension of the Kentucky-Illinois fluorspar district. The chief product of the mines in recent years has been fluorspar, and the yield of galena is small compared with the output from other districts in the Central States.

The total production of galena concentrates in southern Illinois from 1906 to 1929 has been 17,409 tons, most of which has been shipped from the Fairview, Rosiclare, and Hillside mines. The shipments of zinc ores from the district have been comparatively small and scattered. The only recorded shipments of zinc carbonate, aggregating 103 tons, were made from the Empire mine in 1903 or 1904 and from four companies in 1906.

Formerly large bodies of galena near the surface were worked, but galena is now produced incidentally in the concentration of the fluorspar; for this reason it would be misleading to give the quantity of crude ore. The galena of southern Illinois is notably argentiferous as compared with the rest of the Mississippi Valley ores, and the silver content averaged 3.76 to 7.43 ounces to the ton of lead concentrate for the last 13 years.

The first large shipments of sphalerite in many years were made in 1924 from the 250-ton plant of the Fairview Fluorspar & Lead Co., which reported no sales of sphalerite from 1926 to 1929.

The quantity of galena concentrates shipped from southern Illinois increased from 589 tons in 1928 to 668 tons in 1929. Most of the output was from the property of the Hillside Fluor Spar Mines near Rosiclare. The ore is milled at a 250-ton plant equipped with a washing screen, a picking belt, tables, and jigs. The galena concentrates, assaying 68.5 per cent of lead and 5.3 ounces of silver a ton, were shipped to the St. Louis plant of the National Lead Co. The Rosiclare mine also shipped silver-bearing galena concentrates in 1929.

IOWA

The lead and zinc deposits of Iowa extend along the Mississippi River for nearly 80 miles, in Dubuque, Clayton, and Allamakee Counties. No shipments of lead or zinc concentrates from mines in Iowa have been reported since 1917.

KANSAS

By J. P. Dunlop

Mine production of lead and zinc in Kansas in 1929, by districts

District	Lead concentrates [1]		Zinc concentrates		Metal content [2]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Blue Mound-Baxter Springs	30,046	$2,584,202	188,294	$7,664,656	23,186	$2,921,436	98,333	$12,979,956
Crestline	4,041	356,555	6,943	300,318	3,197	402,822	3,516	464,112
Galena	306	21,019	229	8,409	213	26,838	115	15,180
Waco			14,787	577,800			7,886	1,040,952
	34,393	2,961,776	210,253	8,551,183	26,596	3,351,096	109,850	14,500,200
Total, 1928	32,417	2,619,930	204,332	7,680,962	25,276	2,932,016	107,251	13,084,622

[1] Includes 102 tons of lead carbonate, containing 63 per cent lead, from Galena.

[2] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Kansas, 1928 and 1929

	1928		1929	
	Crude ore	Old tailings	Crude ore	Old tailings
Total ore and old tailings milled ... short tons	3,547,100	1,115,100	4,182,600	1,138,500
Total concentrates recovered:				
Galena ... do	32,259	158	34,143	209
Sphalerite ... do	186,113	18,219	193,916	16,337
Ratio of concentrates to ore, etc.:				
Lead ... per cent	0.91	0.01	0.80	0.02
Zinc ... do	5.17	1.63	4.92	1.44
Metal content of ore, etc.:				
Lead ... do	0.72	0.01	0.63	0.01
Zinc ... do	3.09	0.93	2.93	0.82
Average lead content of galena concentrates ... do	79.6	77.8	79.1	60.8
Average zinc content of sphalerite concentrates ... do	59.8	56.6	59.5	57.1
Average value per ton:				
Galena concentrates	$80.09	$74.85	$86.36	$67.00
Sphalerite concentrates	$38.08	$32.67	$41.12	$35.31

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Kansas, 1926–1929

	1926	1927	1928	1929
Total ore and old tailings milled short tons	4,717,500	4,505,800	4,662,200	5,321,100
Total concentrates in ore, etc.:				
Lead per cent	0.81	0.79	0.69	0.63
Zinc do	5.12	4.70	4.33	4.18
Metal content of ore, etc.:				
Lead do	0.62	0.62	0.55	0.50
Zinc do	3.04	2.76	2.61	2.48
Average lead content of galena concentrates do	79.1	78.9	79.6	79.0
Average zinc content of sphalerite concentrates do	59.0	58.8	59.0	59.3
Average value per ton:				
Galena concentrates	$104.92	$88.30	$80.90	$86.08
Sphalerite concentrates	$48.03	$39.88	$37.60	$40.70

The lead and zinc deposits of Kansas, so far as developed, are limited to Cherokee County, in the southeastern part of the State. They form the western extension of the ore deposits of the Joplin region and display the general characteristics shown in that region, except that here typical sheet-ground deposits have not been extensively developed.

It is difficult to ascertain the production for early years or to segregate the Kansas ores from those produced in the Missouri portion of the Joplin region. If to the figures for 1886 to 1903, published by the Kansas Geological Survey,[3] are added those for 1904 to 1929, published in Mineral Resources of the United States, a total of 3,001,843 tons of zinc concentrates and 464,496 tons of lead concentrates is shown as the approximate production of Kansas from 1886 to 1929. About 65 mines, of which 49 are in the Blue Mound-Baxter area, shipped lead or zinc in 1929.

The older mining area at Lawton and Badger-Peacock was not productive in 1929, and shipments of lead and zinc from the Galena district were small. Most of the production came from the Blue Mound-Baxter district, an extension of the Miami field, with substantial outputs from the Waco and Crestline districts. The output of galena from the Crestline district more than doubled, but that of sphalerite decreased 57 tons in 1929. The Kansas side of the Waco camp produced 14,787 tons of sphalerite in 1929, or 8,285 tons less than in 1928. The production of sphalerite from the mines in the Blue Mound-Baxter Springs area increased substantially, and the total increase in zinc concentrates from Kansas in 1929 was 5,921 tons.

Shipments of galena from Kansas mines increased 1,976 tons. The increase was due to the much larger shipments from Crestline in 1929.

Blue Mound-Baxter Springs district.—The shipments of concentrates from the entire Blue Mound-Baxter Springs area in 1929 amounted to 30,046 tons of galena and 188,294 tons of sphalerite, compared with 30,399 tons of galena and 173,424 tons of sphalerite in 1928. The average lead content of the galena sold in 1929 was 78.5 per cent, and the zinc content of the sphalerite was 59.7 per cent. The quantity of crude ore milled increased, but a smaller quantity of old tailings was treated in 1929. The crude ore (tailings excluded) milled in 1929 yielded 6.07 per cent in concentrates, compared with 6.28 per cent in 1928. About 70 per cent of the galena and 75 per cent of the sphalerite shipped from the district came from mines in the vicinity of Blue Mound; these mines shipped 20,850 tons of galena and 141,154 tons of sphalerite. The mines north of Hockerville, Zincville, and near Baxter Springs in Kansas shipped 9,196 tons of galena and 47,140 tons of sphalerite.

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[3] Haworth, Erasmus, and others, History, Geography, and Metallurgy of Galena-Joplin Lead and Zinc: Univ. Kansas Geol. Survey, vol. 8, 1904.

Very little prospecting by drills was done in the Blue Mound-Baxter Springs area in 1929 compared with former years; however, more drill rigs were operated in this area than in any other part of the Joplin region. Practically no development was done near Melrose, as conditions were not favorable for opening up deep ore bodies and consequent heavy expenditure for pumping equipment.

Very few new mills were built or operated in 1929. The Paxton 500-ton mill of the Commerce Mining & Royalty Co. was finished and put into operation in August. The Boska Mining Co. renovated the old Cherokee 200-ton mill, and it is now known as Boska No. 2. The Otis Mining Co. acquired the Morrison land near Baxter Springs, sunk a shaft, and was building a 200-ton plant in December, 1929. The new 500-ton mill on the Ballard land, finished late in 1928, was operated in 1929 by the St. Louis Smelting & Refining Co. The Mid Continent Lead & Zinc Corporation bought the two mines of the Lawyers Mining Co. in July, 1929, and operated one the rest of the year. The Harrington mine was optioned by the Canam Metals Corporation; some development was done, but no concentrates were shipped. The Beck Mining Co. purchased the Vantage No. 4, sunk the shaft to the 220-foot level, and operated the mill part of 1929. The Brugger mine was worked by the Century Zinc Co. until December, when it was sold to the Lee Boston Mining Co. In May, 1929, the Eagle Picher Lead Co. transferred its interest in the Lucky Jew mine to Fred Childress et al., and it has since been acquired by the Jew Mining Co.

The producing properties near Baxter Springs and north of Hockerville and Zincville in 1929 were the Ballard, Boska No. 2, Brugger, Euterpe, Hartley, Hartley-Grantham, Kansas Line, Leopard, Peru, Peru-Laclede (tailing mill), Paul Revere, Paxton, Sonny Boy, and Wyatt. The producing properties in the Blue Mound area were the Barr, Bendelari, Big John, Black Eagle, Blue Mound, Boska, Cherokee, Chubb, Consolidated Nos. 7, 10, and 14, Early Bird (tailings), Fox, Jarrett, Kansouri, King Brand, Lucky Jew, Mid Continent, Monarch, Muncie, Northern, Robinson, Tri State (tailings), Webber, West Side, and Wilbur.

The mines that shipped more than 500 tons each of galena in 1929 were the Barr, Big John, Black Eagle, Blue Mound, Boska, Brugger, Consolidated No. 14, Hartley, Hartley-Grantham, Iron Mountain, King Brand, Leopard, Muncie, Northern, Robinson, Webber, West Side, and Wilbur.

The mines that shipped more than 3,000 tons each of sphalerite in 1929 were the Barr, Bendelari, Black Eagle, Blue Mound, Cherokee, Chubb, Consolidated No. 14, Early Bird (tailings), Euterpe, Hartley, Hartley-Grantham, Iron Mountain, Jarrett, Kansouri, King Brand, Mid Continent, Leopard, Lucky Jew, Monarch, Northern, Peru, Robinson, Tri State (tailings), Webber, West Side, and Wilbur.

Crestline district.—The production in the Crestline district in 1929 was 4,041 tons of galena and 6,943 tons of sphalerite, compared with 1,601 tons of galena and 7,000 tons of sphalerite in 1928. No new mines were operated and little development was done.

The Crutchfield mill was operated steadily and the output was larger than it was in 1928. About 1,600 tons of galena and more than 600 tons of sphalerite were shipped from the Glendale mine. The Crestline Products & Service Co., operating two 300-ton mills equipped with flotation machines, produced 70 per cent of the sphalerite recovered in the district. The Dutch Boy Mining Co. produced more sphalerite in 1929 than in 1928, but its output was mainly galena concentrates. Three mines in the Crestline district produced more galena than sphalerite in 1929, which is unusual in the Joplin region.

Galena district.—The production of lead concentrates in the Galena district in 1929 was 204 tons of galena and 102 tons of lead carbonate, compared with 311 tons of galena and 106 tons of lead carbonate in 1928. The shipments of sphalerite decreased from 836 tons in 1928 to 229 tons in 1929, most of which was from the Central Mining Co. on the Schmidt land. The other shipments of sphalerite in 1929 were made by C. W. Squires, who operated a rock-crushing plant equipped with tables to recover galena and sphalerite from the fines.

The lead concentrates were produced by small operators working on upper levels or culling from old dumps. No effort was made in 1929 to unwater the old mining area, and drilling was confined to territory not connected with the old mines.

Waco district.—The total output of the Waco district in 1929 was 23,349 tons of sphalerite, compared with 62 tons of galena and 26,156 tons of sphalerite in 1928. The district lies partly in Missouri and partly in Kansas; the production in the Kansas part of the district in 1929 was 14,787 tons of sphalerite, compared with 23,072 tons in 1928. The entire output in 1929 came from the mines of the Missouri-Kansas Zinc Corporation and from old tailings milled by the same operator. Six shafts were used to hoist ore mined at 220 to 320 feet; most of the ore was from the lower levels. Each of the mills has a capacity of 500 tons, and there is a large flotation plant equipped with ball mills and 10 Butchart flotation machines which produces about one-fifth of the concentrates. The Grasselli mine and 300-ton mill, now owned by the St. Louis Smelting & Refining Co., were idle in 1929; the company confined its operations in the district to churn drilling.

KENTUCKY

By J P. Dunlop

Lead and zinc deposits occur in both central and western Kentucky. The central districts have not reported any shipments of lead or zinc for more than a score of years. The deposits in the fluorspar region of western Kentucky are chiefly in Crittenden, Caldwell, and Livingston Counties and form a continuation of those in the southern Illinois lead and zinc region.

Considerable quantities of galena ores have been produced in former years, but at present lead is obtained solely as a by-product in the recovery and concentration of fluorspar, which is the principal economic mineral. The galena recovered is argentiferous, and its silver content ranges from a very small quantity to more than 3 ounces a ton, but no recovery of this silver content has been reported by the smelters for many years.

Mine production of lead and zinc in Kentucky, 1920–1929

Year	Lead concentrates (galena)		Zinc concentrates				Metal content			
			Sphalerite		Zinc carbonate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1920	172	$12, 295	--------	----------	25	$750	122	$19, 520	9	$1, 458
1921	100	3, 693	--------	----------	621	19, 800	69	6, 210	220	22, 000
1922	132	8, 365	--------	----------	419	8, 373	92	10, 120	142	16, 188
1923	78	6, 152	--------	----------	850	17, 925	53	7, 420	270	36, 720
1924	259	22, 908	--------	----------	1, 494	37, 000	175	28, 000	492	63, 960
1925	251	23, 619	--------	----------	1, 217	29, 740	152	26, 448	429	65, 208
1926	92	7, 537	582	$17, 471	4, 478	116, 417	58	9, 280	1, 838	275, 700
1927	241	14, 070	352	5, 392	2, 136	46, 514	139	17, 514	860	110, 080
1928	59	4, 959	--------	----------	265	6, 032	39	4, 524	92	11, 224
1929	496	29, 623	--------	----------	--------	----------	287	36, 162	--------	----------

The total value of the lead and zinc concentrates shipped from Kentucky mines in 1929 was $29,623, compared with $10,991 in 1928. The Franklin Fluorspar Co. was the largest shipper in 1929. Other shippers were the Eagle Fluor Spar Co., Lafayette Fluorspar Co., Holly Fluorspar Co., S. L. Crook Corporation, and the Zinc & Spar Co. No shipments of zinc concentrates were reported from either the Hudson or the Sheridan mines in 1929.

MICHIGAN

By H. M. Meyer

The output of refined copper in Michigan in 1929 amounted to 186,402,218 pounds, an increase from 178,442,704 pounds in 1928, and the largest production on record since 1918. The production in 1929 was from 7,598,180 tons of rock which yielded 286,583,602 pounds of mineral, compared with 7,361,658 tons of rock and 283,405,073 pounds of mineral in 1928.

Mine production of silver and copper in Michigan, 1921–1929 [1]

Year	Silver (fine ounces)	Copper [2]			Concentrate ("mineral") [3]		Ore [4] ("rock") (short tons)
		Pounds	Yield		Pounds	Yield (per cent)	
			Pounds per ton of ore ("rock")	Percentage			
1921	310, 727	86, 370, 028	23. 9	1. 19	148, 024, 931	58. 4	3, 610, 648
1922	376, 990	121, 712, 365	24. 6	1. 23	193, 984, 975	62. 7	4, 952, 264
1923	223, 997	138, 304, 080	25. 8	1. 29	220, 055, 091	62. 8	5, 363, 160
1924	130, 381	135, 662, 605	25. 3	1. 26	213, 779, 365	63. 5	5, 372, 572
1925	139, 499	155, 157, 488	22. 0	1. 10	241, 056, 386	64. 4	7, 036, 751
1926	105, 242	175, 381, 565	23. 0	1. 15	272, 365, 636	64. 4	7, 641, 682
1927	97, 193	177, 537, 775	22. 1	1. 10	275, 460, 828	64. 5	8, 046, 334
1928	17, 153	178, 442, 704	24. 2	1. 21	283, 405, 073	63. 0	7, 361, 658
1929	20, 795	186, 402, 218	24. 5	1. 23	286, 583, 602	65. 0	7, 598, 180

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[1] The figures are based on the actual recovery of copper from "mineral" smelted and the estimated recovery from "mineral" that was not smelted during the year.

[2] Includes copper from sands.

[3] Includes "mineral" from sands.

[4] Includes sands.

Value of silver and copper produced in Michigan mines, 1921–1929

Year	Silver	Copper		Total
		Total	Per ton of ore ("rock")	
1921	$310, 727	$11, 141, 734	$3. 09	$11, 452, 461
1922	376, 990	16, 431, 169	3. 32	16, 808, 159
1923	183, 678	20, 330, 700	3. 79	20, 514, 378
1924	87, 355	17, 771, 801	3. 31	17, 859, 156
1925	96, 812	22, 032, 363	3. 13	22, 129, 175
1926	65, 671	24, 553, 419	3. 21	24, 619, 090
1927	55, 109	23, 257, 449	2. 89	23, 312, 558
1928	10, 035	25, 695, 749	3. 49	25, 705, 784
1929	11, 084	32, 806, 790	4. 32	32, 817, 874

F. G. Pardee, mine appraiser of Michigan, has issued a statement covering the cost of producing copper in Michigan in 1929. The average cost per pound for the district (mines only) was 13.6936 cents in 1929, compared with 12.0780 cents in 1928. The large increase in the cost of labor, equivalent to 0.9 cent a pound, was the principal factor in the increased cost of copper production in 1929. The average price received for copper was 17.8511 cents for 1929, compared with 14.7555 cents in 1928, an increase of 3.0956 cents; consequently, the average profit was higher in 1929, being 4.1575 cents compared with 2.6775 cents in 1928. In the 1928 report of this series the costs given are costs at mines and reclamation plants. Similar costs for 1929 are not reported. The details of the cost in 1929 are shown in the following statement taken from Pardee's report:

Average cost per pound of Michigan copper production in 1929

	Cents per pound
General expense:	
General property tax	0. 4430
State corporation tax	. 0534
Depreciation	1. 4167
General office	. 1287
Other general expense	. 5328
	2. 5746
Mining cost:	
Labor	5. 3984
Supplies	2. 8191
	8. 2175
Treatment cost:	
Transportation (rock to mill)	. 4194
Concentrating	1. 2778
Transportation to smelter	. 0427
Smelting and refining	. 7376
	2. 4775
Selling and delivery expense	. 4240
Other costs:	
Construction and installation of equipment	. 5795
Income tax	. 3705
Average price of copper	17. 8511
Average profit	4. 1575
Gross cost	13. 6936

The valuations of the copper mines as shown in Pardee's report are as follows:

Houghton County:	
Calumet & Hecla Consolidated Copper Co.—	
Ahmeek mill and railroad	$800, 000
Centennial	200, 000
Calumet & Hecla conglomerate	3, 045, 000
Osceola	1, 750, 000
North Kearsarge	300, 000
Reclamation	10, 000, 000
	16, 095, 000
Copper Range Co.—	
Champion mine	3, 215, 000
Baltic mine	150, 000
Trimountain	100, 000
	3, 465, 000
Isle Royale Copper Co	1, 250, 000
Quincy Mining Co. (including railroad)	1, 250, 000
Arcadian Consolidated Copper Co	90, 000
Franklin Mining Co	100, 000
Mayflower-Old Colony Copper Co	40, 000
Hancock Consolidated Copper Co	49, 000
La Salle Copper Co	80, 000
Superior Copper Co	20, 000
Winona Copper Co	65, 000
Total, Houghton County	22, 504, 000
Keweenaw County:	
Calumet & Hecla Consolidated Copper Co.—	
Cliff & Phoenix	100, 000
Ahmeek & Allouez	6, 450, 000
Mohawk Mining Co	2, 200, 000
Seneca Copper Mining Co	850, 000
Douglass Copper Co	40, 000
Total, Keweenaw County	9, 640, 000
Grand total, Houghton and Keweenaw Counties	32, 144, 000

The mines of the Calumet & Hecla Consolidated Copper Co. produced 90,319,000 pounds of copper in 1929 at an average cost sold (not including depreciation or depletion) of 11.43 cents a pound, compared with 91,308,000 pounds of copper at an average cost sold of 10.1 cents a pound in 1928. In addition 33,511,000 pounds of copper was recovered at the reclamation plants at Lake Linden and Hubbell at an average cost sold of 5.62 cents a pound, compared with 29,896,000 pounds at an average cost sold of 5.95 cents a pound in 1928. The average price received by this company for copper delivered during 1929 was 17.69 cents a pound. The operations at the reclamation plants constituted a new high record of production, recovery, and profit and a new low record of costs. At the Lake Linden plant six months operations were on the Hecla bank and six months on the Calumet bank. The operations on the Calumet bank left it virtually though not entirely exhausted after a total production from the beginning of operations of 193,376,500 pounds, approximately 95 per cent of the estimated recoverable quantity. The total production at the Lake Linden plant to the end of 1929 has been

212,598,000 pounds, and the total production at the Lake Linden and Tamarack (Hubbell, Mich.) plants has been 250,799,000 pounds. The company estimates that it will produce 252,000,000 pounds at these plants in the future; it would take only about eight years to exhaust this quantity at the 1929 rate of production, but, apparently, a smaller annual output with consequently a longer life is in prospect. The combined results of the two plants for 1929 and from the beginning of operations are shown in the following table:

Operations at the Calumet & Hecla reclamation plants at Lake Linden and Hubbell in 1929 and for the entire period of their operation

	1929	Since starting
Quantity treated .... short tons..	2, 444, 000	23, 223, 000
Assay headings .... per cent..	0. 782	0. 681
Assay tailings .... do....	0. 100	0. 141
Refined copper produced .... pounds..	33, 511, 000	250, 799, 000
Refined copper produced per ton treated .... do....	13. 71	10. 80

Of the quantity shown for 1929, 9,818,000 pounds was from table treatment following grinding, 19,622,000 pounds from leaching, and 4,071,000 pounds from flotation. The Calumet and Ahmeek stamp mills operated to capacity during the year, and the Lake Milling Co.'s No. 2 mill at Hubbell stamped some Osceola amygdaloid as well as all of the rock of the Seneca Copper Mining Co. Extensive maintenance repairs were made at the Hecla and Osceola mills, which have been idle for about 10 years. Progress was reported on the installation of Fahrenwald flotation machines, mentioned in the 1928 report of this series, in the Ahmeek mill. Recovery has shown the increase anticipated and further improvement along these lines is dependent upon finer grinding of Kearsarge lode jig tailings, which in turn is dependent on additional power now being provided. The Calumet mill treated 840,960 tons of conglomerate and 249,040 tons of Osceola amygdaloid; the Ahmeek mill, 1,269,615 tons of Kearsarge and 605,418 tons of Osceola; and the Lake No. 2 mill, 7,827 tons of Kearsarge, 154,887 tons of Osceola amygdaloid, a test run of 1,523 tons of conglomerate, and all of the rock of the Seneca Copper Mining Co. The smelter received 101,900 tons of concentrates and mass and smelted 97,700 tons, which yielded 122,664,000 pounds of refined copper. A new mineral building, with 10 main compartments, which provides storage for 15,000 tons of mineral has been in use since April, 1929. Its principal advantage lies in the facility it affords for the thorough mixing of the different grades of mineral with the coal screenings and fluxes used in melting. At the No. 2 mill of the Lake Milling, Smelting & Refining Co. 139,440 tons were treated for the Seneca Copper Mining Co. in addition to the tonnage given above. Fahrenwald flotation machines were installed for treating primary fines and Hardinge mill product from jig middlings. Exploration work was continued at Cliff and Phoenix. Dividends totaling $9,024,759, $4.50 a share, were paid during the year, compared with $5,013,755, $2.50 a share, in 1928.

The Isle Royale Copper Co. treated 515,024 tons of rock during the year from which 10,864,085 pounds of refined copper or 21.09 pounds to the ton was produced, compared with 440,731 tons in 1928 which yielded 10,520,771 pounds of refined copper or 23.87 pounds to the ton. The average cost of the copper sold (not including depreciation and depletion) was 14.01 cents a pound, and the average price received for copper sold during the year was 18.21 cents a pound. This company paid dividends totaling $300,000 in 1929, compared with $262,500 in 1928.

The comparative results of the Isle Royale Copper Co. for the past four years are summarized in the following table:

Copper produced by the Isle Royale Copper Co., 1926–1929

	1926	1927	1928	1929
Rock hoisted short tons	564, 692	593, 594	560, 598	669, 049
Rock-house discard do	116, 945	128, 494	119, 867	154, 025
Rock treated do	447, 747	465, 100	440, 731	515, 024
Cost of mining, transportation, stamping, and taxes per ton of rock	$2. 39	$2. 50	$2. 71	$2. 67
Refined copper produced pounds	11, 017, 000	11, 391, 338	10, 520, 771	10, 864, 085
Refined copper per ton of rock treated do	24. 61	24. 49	23. 87	21. 09

Total copper production by the Champion, Baltic, and Trimountain mines was virtually unchanged, being 24,197,316 pounds in 1929, compared with 24,254,132 pounds in 1928. Production was higher at the Champion mine and lower at the Baltic mine. Of these quantities 13,866,966 pounds was produced for the Copper Range Co. in 1929 and 14,472,364 pounds in 1928, one-half of Champion's output belonging to St. Mary's Mineral Land Co. Operations at the Baltic and Trimountain mines have been conducted at a loss, with one or two exceptions, for the past 10 years. Prior to 1920 the Baltic mine showed total profits of $13,958,364.87, but development and exploration of the mine at depth have proved that the original ore deposit is continuous below the 25 level at the south end of the mine only and for a length too short to permit profitable operation. The company plans to determine by diamond drilling the character of the lode below the present workings on the 47 level and, if the results are disappointing, to extract the developed ore preparatory to closing down the mine. Diamond drilling will be done below the present workings at Trimountain, but the company will not continue to operate this property at a loss. During the year the Copper Range Co. acquired the White Pine Copper Co., the Victoria Copper Co., control of the National Mining Co. and mineral rights adjacent to the Atlantic mine. Dividends totaling $789,510 were paid during the year, compared with $394,755 in 1928.

Copper produced by the Champion Copper Co., 1920–1929

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound [1]	Price received	Net profits
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*	
1920	321, 664	13, 610, 324	42. 419	14. 40	17. 17	$399, 772. 65
1921	531, 780	20, 719, 307	39. 018	9. 82	13. 329	719, 955. 51
1922	503, 593	19, 583, 806	38. 964	9. 93	14. 359	890, 515. 16
1923	449, 130	18, 412, 630	41. 03	11. 14	14. 86	738, 871. 98
1924	457, 160	20, 061, 630	43. 88	10. 49	13. 76	709, 276. 53
1925	414, 645	17, 957, 605	43. 308	11. 73	14. 258	497, 764. 43
1926	454, 654	17, 658, 820	38. 84	10. 83	13. 948	597, 042. 27
1927	403, 260	16, 098, 926	39. 92	10. 84	13. 42	455, 791. 07
1928	427, 240	19, 563, 535	45. 79	11. 10	15. 01	829, 357. 45
1929	446, 804	20, 660, 701	46. 24	12. 00	17. 94	1, 267, 685. 97

[1] Excludes depreciation and depletion.

Copper produced by the Baltic mine, 1920–1929

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound [1]	Price received	Net loss
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*	
1920	175, 357	6, 613, 918	37. 71	18. 02	17. 11	$59, 882. 60
1921	195, 816	7, 608, 847	38. 86	14. 15	13. 078	81, 668. 95
1922	165, 804	5, 329, 568	32. 14	16. 76	13. 958	149, 578. 09
1923	137, 801	4, 877, 248	35. 51	18. 42	14. 626	189, 880. 94
1924	150, 101	4, 769, 286	31. 77	15. 95	13. 76	104, 574. 24
1925	140, 958	4, 255, 069	30. 18	17. 74	14. 25	148, 517. 14
1926	126, 157	3, 690, 041	29. 25	18. 28	13. 94	160, 073. 52
1927	121, 504	4, 207, 819	34. 63	13. 50	13. 42	3, 120. 98
1928	92, 742	3, 415, 082	36. 82	14. 54	15. 01	[2] 16, 085. 53
1929	53, 833	2, 127, 926	39. 53	20. 87	17. 94	62, 339. 97

[1] Excludes depreciation and depletion.
[2] Net profit.

Copper produced by the Trimountain mine, 1920–1929

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound [1]	Price received	Net loss
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*	
1920	116, 768	3, 532, 025	30. 24	25. 51	17. 115	$247, 390. 52
1921	143, 172	4, 341, 584	30. 32	18. 27	13. 078	183, 560. 50
1922	130, 913	4, 116, 100	31. 44	16. 46	13. 95	67, 576. 58
1923	6, 273	281, 482	44. 87	(2)	14. 62	140, 563. 74
1924	8, 159	278, 259	34. 10	(2)	13. 76	87, 053. 47
1925	35, 465	1, 065, 044	30. 03	(2)	14. 25	39, 302. 47
1926	63, 837	2, 177, 416	34. 11	13. 43	13. 94	[3] 11, 253. 16
1927	67, 281	2, 354, 808	35. 00	12. 25	13. 42	[3] 27, 476. 86
1928	38, 950	1, 275, 515	32. 74	16. 90	15. 01	24, 100. 34
1929	42, 763	1, 408, 689	32. 94	22. 06	17. 94	57, 968. 20

[1] Excludes depreciation and depletion.
[2] Figures not given.
[3] Net profit.

The Mohawk Mining Co. hoisted 637,156 tons of rock in 1929 and stamped 619,585 tons, from which 27,865,390 pounds of mineral which yielded 20,043,127 pounds of refined copper was produced. These figures compare with 676,436 tons of rock hoisted, 656,739 tons of rock stamped, and 30,002,000 pounds of mineral and 21,243,265 pounds of copper produced in 1928. The cost of producing copper was reduced from 7.623 cents a pound in 1928 to 7.316 cents a pound in 1929, which was the lowest production cost in the history of the company with the exception of that for 1915. The engineers of the company estimated a life for the Mohawk mine of five or six years. Dividends for the year totaled $920,000, compared with $690,000 in 1928.

Copper produced by the Mohawk Mining Co. in 1929

Rock hoisted	short tons	637, 156
Rock stamped	do	619, 585
Product of mineral	pounds	27, 865, 390
Refined copper produced	do	20, 043, 127
Yield per ton of rock treated	do	32. 349
Cost per ton of rock hoisted		$1. 808
Cost per ton of rock stamped		$1. 859
Operating cost per pound of refined copper	cents	5. 746
Cost of taxes	do	. 291
Cost of smelting, freight, and marketing product, including eastern offices' expenses	cents	1. 279
		7. 316

The Quincy Mining Co. produced 7,088,500 pounds of mineral which yielded 4,459,426 pounds of refined copper in 1929. Production was mostly from development operations with less than 25 per cent of the rock stamped secured from stoping. The mineral produced in 1928 amounted to 1,891,200 pounds which yielded 1,220,536 pounds of refined copper. Operations at Quincy in 1928 and 1929 have been confined chiefly to shaft sinking, drifting, recovery of No. 2 shaft in which a fire occurred in 1927, and extending the openings of the mine for the re-treating stope method of mining on a large scale. The company reports very good progress in 1929 in opening the mine for production on a broad scale and putting the property in condition to operate at a profit. Net operating loss in 1929 amounted to $88,269.01 which with capital expenditures during the year of $716,010.15 for opening the mine and $412,381.99 for construction work made a total excess of expenditures over income of $1,216,661.15. One small reverberatory furnace handled the mine production at a cost which would indicate a low cost in the future when production has increased sufficiently to start the large No. 5 furnace and casting machine. The smelter has been maintained in good physical condition.

Copper produced by the Quincy Mining Co., 1924–1929

Year	Copper rock and mass	Mineral	Copper	Yield of copper per ton of rock
	Short tons	*Pounds*	*Pounds*	*Pounds*
1924	588,100	24,489,920	14,838,633	25.24
1925	586,913	22,721,380	14,357,523	24.46
1926	517,900	20,220,795	13,290,052	25.66
1927	413,000	15,336,690	9,718,662	23.53
1928	60,834	1,891,200	1,220,536	20.06
1929	207,833	7,088,500	4,459,426	21.46

The Seneca Copper Mining Co. produced 2,999,882 pounds of refined copper in 1929.

MISSOURI

By J. P. Dunlop

The value of the mine production of silver, copper, lead, and zinc in Missouri in 1929 was $26,558,545, compared with $24,361,227 in 1928. The value of the silver decreased $6,638, that of copper $8,966, and that of zinc $128,584; the value of lead increased $2,341,506. The mine production of lead in Missouri in 1929 was equivalent to 29.5 per cent of the smelter production of primary lead from domestic sources in the United States, compared with 31.2 per cent in 1928; and the mine production of zinc in Missouri was 1.8 per cent of the total primary zinc produced by smelters from domestic ores in 1929, compared with 2.2 per cent in 1928 and 22.7 per cent in 1917. About 45 mines and prospects in Missouri shipped lead or zinc concentrates in 1929.

Mine production of copper and silver in Missouri, 1920–1929

Year	Copper		Silver	
	Pounds	Value	Fine ounces	Value
1920	1,512,539	$278,307	111,128	$121,130
1921	137,591	17,749	69,902	69,902
1922	797,400	107,649	212,656	212,656
1923	202,556	29,776	177,270	145,361
1924	182,811	23,948	103,694	69,475
1925	12,100	1,718	83,340	57,838
1926	1,077,000	150,780	90,000	56,160
1927	451,000	59,081	233,931	132,638
1928	65,000	9,360	176,840	103,451
1929	2,240	394	181,638	96,813

The silver content of the lead ores is so small that it is disregarded in the assay and sale of the concentrates. For this reason the smelter reports must be relied on for the silver production. The quantity of silver produced in any year bears no direct ratio to the quantity of lead concentrates smelted during that year, because the silver content is so small that the silver bullion is stored and refined in batches. Over a series of years the concentrates average about 1 ounce of silver to the ton.

All of the copper produced in 1929 was derived from matte recovered in smelting lead ores; no copper ore was shipped in 1929.

The value of the lead and zinc from concentrates produced in Missouri in 1929 was $26,461,338, an increase of $2,212,922 over the value in 1928. The production of lead concentrates (of which only 154 tons was lead carbonate) was 279,403 tons, compared with 276,502 tons in 1928. Of the total output in 1929, 277,986 tons was derived from southeastern Missouri, an increase of 3,061 tons. The average lead content of the galena concentrates from this district was 72.7 per cent in 1929, compared with 72.1 per cent in 1928, and the value of the galena concentrates per ton in 1929 was $75.61, compared with $69.50 in 1928. The lead derived from galena concentrates in southeastern Missouri in 1929 was 197,435 tons, an increase of 3,165 tons.

Shipments of galena concentrates from southwestern Missouri in 1929 were 1,263 tons, compared with 1,413 tons in 1928. Shipments of lead carbonate concentrates in 1929 were 154 tons, a decrease of 10 tons. The quantity of lead recovered from concentrates shipped from southwestern Missouri was 1,034 tons, a decrease of 89 tons. The average lead content of the galena concentrates from southwestern Missouri in 1929 was 76.3 per cent, and the average value of the galena concentrates per ton was $82.31, or $7.15 more than in 1928.

The total quantity of sphalerite concentrates from Missouri mines in 1929 was 20,339 tons, a decrease of 3,655 tons compared with 1928; 13,308 tons of the total came from southwestern Missouri. The concentrates sold at an average price of $40.53 a ton and had an average zinc content of 60.3 per cent, compared with an average price of $38.38 and an average assay of 59.9 per cent in 1928. The shipments of sphalerite concentrates from southeastern Missouri were 7,031 tons of 58.1 per cent concentrates. With the operation of the new Desloge mill and flotation plant the output will probably increase if prices warrant a large output of lead.

The zinc carbonate and silicate concentrates sold in 1929 amounted to 1,352 tons, or 365 tons more than in 1928. The output came entirely from southwestern Missouri. The average zinc content of these concentrates was 40.2 per cent, and the average value per ton was $21.24, compared with 39.5 per cent and $20.97 in 1928.

The value of the galena concentrates from southeastern Missouri (which produced 99 per cent of the total for the State) was $21,017,310, or $1,909,419 more than in 1928, and the value of the sphalerite concentrates was $277,332, or $41,221 more than in 1928. The total value of the lead and zinc concentrates shipped from southwestern Missouri was $681,167, compared with $804,411 in 1928.

The total quantity of crude ore and old tailings treated in Missouri in 1929 was 6,868,000 tons. The total amount received for all classes of lead and zinc concentrates sold in 1929 was $21,975,809, an average of $3.20 to the ton of ore and tailings treated, or 14 cents more than in 1928.

In the following tables, showing the tenor of ore ("dirt") and concentrates from Missouri, it has been considered advisable to segregate ores of different nature. The disseminated lead ore of southeastern Missouri differs radically from the lead and zinc ores of the so-called "soft-ground" deposits of southwestern Missouri. Each class of ore has its peculiar problems of mining and ore dressing. The data are given for the ores mined in the Joplin region, but there have been no recoveries from "sheet ground" since 1921. In general, the tables reflect very closely the conditions of the industry.

Mine production of lead and zinc in Missouri in 1929, by districts

District	Lead concentrates				Zinc concentrates			
	Galena		Carbonate		Sphalerite		Silicate and carbonate	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Aurora	71	$6,370	20	$1,200	40	$1,684	610	$14,100
Duenweg-Porto Rico	2	170	4	250			221	4,600
Granby	114	8,397					113	1,948
Joplin	659	55,004	100	6,000	1,661	66,496	4	80
Oronogo	68	5,438			2	31		
Spring City-Spurgeon	140	10,012	30	2,000			404	7,982
Taney County	5	425						
Waco					8,562	340,228		
Webb City-Carterville-Prosperity	203	17,781			74	2,520		
Zincite-Klondike-Smithfield	1	96			2,969	128,355		
	1,263	103,693	154	9,450	13,308	539,314	1,352	28,710
Central and southeastern Missouri	277,986	21,017,310			7,031	277,332		
	279,249	21,121,003	154	9,450	20,339	816,646	1,352	28,710
Total, 1928	276,338	19,213,996	164	9,840	23,994	903,884	987	20,693

Mine production of lead and zinc in Missouri in 1929, by districts—Continued

District	Metal content [1]			
	Lead		Zinc	
	Short tons	Value	Short tons	Value
Aurora	65	$8, 190	238	$31, 416
Duenweg-Porto Rico	4	504	75	9, 900
Granby	78	9, 828	40	5, 280
Joplin	565	71, 190	837	110, 484
Oronogo	43	5, 418	1	132
Spring City-Spurgeon	115	14, 490	142	18, 744
Taney County	4	504		
Waco			4, 577	604, 164
Webb City-Carterville-Prosperity	159	20, 034	34	4, 488
Zincite-Klondike-Smithfield	1	126	1, 600	211, 200
	1, 034	130, 284	7, 544	995, 808
Central and southeastern Missouri	197, 435	24, 876. 810	3, 473	458, 436
	198, 469	25, 007, 094	11, 017	1, 454, 244
Total, 1928	195, 393	22, 665, 588	12, 974	1, 582, 828

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[1] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and concentrates produced in southwestern Missouri, 1926–1929

	1926	1927	1928	1929
Total ore short tons	1, 025, 500	513, 800	281, 300	428, 400
Total concentrates in ore:				
Lead per cent	0. 52	0. 66	0. 56	0. 33
Zinc do	4. 76	5. 57	5. 47	3. 80
Metal content of ore:				
Lead do	0. 39	0. 50	0. 41	0. 25
Zinc do	2. 77	3. 21	3. 23	2. 26
Average lead content of galena concentrates do	76. 8	76. 5	74. 2	76. 3
Average lead content of lead carbonate concentrates do	60. 0	60. 0	59. 1	60. 0
Average zinc content of sphalerite concentrates do	59. 6	58. 3	59. 9	60. 3
Average zinc content of silicates and carbonates do	39. 3	38. 2	39. 5	40. 2
Average value per ton:				
Galena concentrates	$105. 74	$83. 26	$75. 16	$82. 31
Lead carbonate concentrates	$78. 87	$60. 00	$60. 00	$61. 36
Sphalerite concentrates	$49. 01	$40. 08	$38. 38	$40. 53
Zinc silicates and carbonates	$31. 61	$26. 26	$20. 97	$21. 24

Tenor of lead ore and concentrates in southeastern Missouri disseminated-lead district, 1926–1929

	1926	1927	1928	1929
Total lead ore short tons	6, 261, 600	6, 310, 200	6, 292, 500	6, 439, 600
Galena concentrates in ore per cent	4. 80	4. 42	4. 37	4. 31
Lead content of ore do	3. 32	3. 17	3. 17	0. 11
Average lead content of galena concentrates do	69. 0	71. 7	72. 1	72. 7
Average value per ton of galena concentrates	$93. 98	$83. 62	$69. 50	$75. 61
Average zinc content of sphalerite concentrates per cent				58. 1
Average value per ton of sphalerite concentrates				$39. 44

Mineral Resources for 1914, Part I, pages 72 to 77 and 97 to 100, gave a brief history of lead and zinc mining in the southeastern Missouri and Joplin regions, as well as data relating to the total lead and zinc production, the mining and milling practice, the character of the ore and concentrates, and the methods of selling them.

SOUTHWESTERN MISSOURI

Area and production.—The southwestern Missouri lead and zinc areas include the largest part of the Joplin region, the remainder lying in southeastern Kansas and northeastern Oklahoma.

Lead and zinc concentrates produced in the Missouri part of the Joplin region, 1907–1929

	Short tons	Value	
		Total	Average
Lead concentrates	462, 133	$29, 915, 478	$64. 73
Sphalerite concentrates	2, 928, 222	148, 431, 229	50. 69
Zinc carbonate and silicate concentrates	306, 142	9, 444, 998	30. 85
	3, 696, 497	187, 791, 705	----------

Prices.—The following quoted base prices apply not only to southwestern Missouri but also to all the mines in Oklahoma and Kansas that are in the Joplin region, except that small scattered lots of concentrates of less than a carload bring slightly lower prices. The high-grade sphalerite containing less than 0.20 per cent of lead, of which there was about 50,000 tons in 1929, brought during most of 1929, $1 premium above the base price. Occasionally during 1929 the demand for these high-grade concentrates was very active, but there were also periods in which they were in very slow demand and there was a disinclination to pay any premium. There seems to be an ample supply of high-grade concentrates as some smelters now purchase zinc concentrates high in lead and extract the lead on tables at the smelter. Very little flotation concentrate was mixed with jig and table concentrates, as smelters did not desire the mixed concentrate. The all-flotation zinc concentrates containing above 55 per cent of zinc continued to bring in 1929 a price $3 under the price of jig and table sphalerite concentrate. With a base price of $40 for 60 per cent jig and table sphalerite concentrates, a 55 per cent flotation concentrate brought $32 a ton. The tenor of the buying changed near the end of 1929, as the flotation concentrate was more in demand than the coarse concentrate and smelters equipped to handle flotation concentrates apparently found the $3 differential in base price very attractive. The differential, however, was not cut until early in 1930.

The buying late in 1929 cleaned up a large quantity of the mixed concentrates in stock, and at the end of 1929 the stocks of zinc concentrates (which had increased from about 25,000 tons on December 31, 1928, to about 45,000 tons on December 31, 1929) were largely those of the coarser and higher-grade concentrates.

The base price for zinc concentrates ranged from $44 to $35 a ton during 1929. It was unusually stable at $44 a ton from the end of March to the last week in October.

The opening prices in 1929 were $41 for high-grade concentrates, $40 for other coarse concentrates, and $37 for flotation concentrates. These prices held until the first week in February, when the price advanced $1 a ton. In the third week in March the base price was $42.50 a ton and in the first week in April it advanced to $44, where it held until the last week in October. November brought recessions first to $42, then to $40, and in the last week to $38. The $38 base price only held for two weeks, when it was reduced to $36. The third week in December brought a quotation of $35 (the lowest in 1929), at which price it remained the last two weeks of 1929.

No base prices were quoted for zinc silicate in 1929, as demand and production were both small and spasmodic. The milled zinc silicate in car lots was taken when offered but small lots of hand-cobbed ore were not wanted.

In 1929 the prices quoted for galena carrying 80 per cent of lead showed the large variation of $30 a ton, compared with $12.50 a ton in 1928. The quoted price for January opened at $85 a ton, advancing the second week to $87.50. In February successive weekly advances carried the quoted price to $95. The March price opened at $97.50 and closed at $105, the highest price of 1929. The April price opened at $100, decreased first to $92.50, and then to $90, where it held until the end of June. The July quotations were $85 to $87.50. The August, September, and October quotation was $87.50. The price slumped quickly to $80 the first week in November, and in the second week in November there was a further decline to $75, a price which held until the end of 1929. The fairly good prices paid for galena concentrates during most of 1929 resulted in a decrease of 12,000 tons in the stocks at mines at the end of the year.

Average prices per ton paid for sphalerite, and zinc and lead concentrates in southwestern Missouri, 1921–1929

	1921	1922	1923	1924	1925	1926	1927	1928	1929
Sphalerite	$25.18	$31.91	$40.52	$41.91	$54.18	$49.01	$40.08	$38.38	$40.53
Zinc silicate or carbonate concentrates	10.57	21.25	26.57	24.29	30.80	31.61	26.26	20.97	21.24
Galena concentrates	50.15	69.44	83.40	101.31	110.51	105.74	83.26	75.16	82.31

General conditions.—Only about 18 mills were operated in southwestern Missouri in 1929, and practically none was operated continuously. The number of gougers and small lessees was even less in 1929 than in 1928 and drilling was inactive. Some mines were abandoned and others were shut down until mining conditions became more favorable. There was no mining in 1929 in the Carthage, Alba-Neck City, Carl Junction, Racine, Wentworth, and Webb City camps. Work at the Oronogo, Granby, and Spurgeon camps was confined to scrapping. In southwestern Missouri there was a decrease of 4,089 tons of sphalerite and 150 tons of galena; the quantity of zinc silicate shipped increased 365 tons. There is every indication of a decrease in 1930 in all classes of concentrates.

The Missouri part of the Waco district produced 64 per cent of the sphalerite shipped in 1929, although there were only two producers. The Missouri-Kansas Zinc Corporation operated the old Barnsdall properties and the renovated 400-ton mill. Ore from three levels and a considerable quantity of tailings were treated. This corporation also acquired the Allegheny Western, Blue Bird, Pyramid, and Tulsa-Pittsburg mines, so that it now controls the southern part of the camp. The Universal Exploration Co. mine was taken over by the Gascho Mining Co. in September, 1929, the two shafts were sunk from the 210-foot level to 250 feet, and the 300-ton mill was operated until the end of the year. The mines of the Missouri Mining Co. and the St. Louis Smelting & Refining Co. were not worked in 1929.

The Smithfield camp was the second largest shipper of sphalerite in 1929. The output was less than in 1928, and a large part of the concentrates were not sold. The Isherwood 250-ton plant continued its output of very high-grade zinc concentrates. Other shippers were the Midwood Mining Co. and the Octagon Mining Co. The Missouri Mining Co. erected a 200-ton pilot plant to test the recovery from sheet-ground ore at the old A. W. C. leases in the West Joplin district. This mill was the largest producer of galena in southwestern Missouri in 1929. Two mills that produced in 1929, since destroyed by fire, were the Riverside and the White Shirt. The Superior Lead & Zinc Co. sunk shafts on the Rex land to mine ore on the 130-foot level; the ore was treated at a new 150-ton mill completed in July, 1929. The Four Corners Mining Co. had a good output of both lead and zinc from its mine near Joplin. The St. Charles Mining Co. was the largest producer of galena and zinc silicate in the Spring City-Spurgeon area, and most of the concentrates shipped from Duenweg were produced by the Joplin Mining Co. The Barbo Mining Co.'s 200-ton mill was operated on custom ore from mines in the Aurora camp; the mines were opened up in 1929 after a long period of idleness. Some of these producing mines in 1929 were the Belle Alice, Blue Bird, Bull Frog, and Triangle.

CENTRAL AND SOUTHEASTERN MISSOURI

A brief description of the ore deposits in central and southeastern Missouri is given in the chapter of this series for 1915.

Copper, silver, nickel, and cobalt occur in the ore in considerable quantity near Fredericktown and in small quantity irregularly in nearly all the deep mines of this region. It is only near Fredericktown that the copper, nickel, and cobalt content of the ore has been the object of mining, yet a concentrate of these metals has been recovered as a table middling at several plants in other parts of the district.

In the disseminated-ore district the production increased rapidly after 1869 and is estimated by Buckley to have amounted to 1,202,607 tons of lead concentrates, valued at $59,869,354, for the period 1869 to 1906, inclusive. The mine production of southeastern and central Missouri has been reported annually since 1907.

The output of silver in Missouri in 1929 was derived from refining pig lead or from copper matte or zinc concentrates recovered in milling or smelting lead ores.

Mine production of lead and zinc concentrates in southeastern and central Missouri, 1907–1929

Year	Lead concentrates (galena)		Zinc concentrates			
			Sphalerite		Carbonate and silicate	
	Short tons	Value	Short tons	Value	Short tons	Value
1907–1919	3,060,687	$168,097,744	1,016	$44,137	10,224	$231,624
1920	242,248	19,799,389	---------	---------	61	1,910
1921	280,358	11,737,400	---------	---------	---------	---------
1922	271,294	14,779,869	---------	---------	---------	---------
1923	259,320	19,434,633	---------	---------	---------	---------
1924	292,604	24,739,819	---------	---------	---------	---------
1925	314,403	31,727,170	---------	---------	---------	---------
1926	300,480	28,239,733	2,301	101,243	---------	---------
1927	279,441	23,360,294	8,390	289,816	---------	---------
1928	274,925	19,107,891	6,597	236,111	---------	---------
1929	277,986	21,017,310	7,031	277,332	---------	---------

The lead ore mined in the disseminated-lead district in 1929, amounting to 6,439,600 tons, yielded 4.31 per cent of galena concentrates which averaged 72.7 per cent of lead. The average value per ton of lead concentrates was $75.61, compared with $69.50 in 1928; the output of galena concentrates was about 277,850 tons, compared with 274,900 tons in 1928. As the two largest producers not only mine but also smelt their lead concentrates, the values given for concentrates are to a certain extent arbitrary. The galena concentrates produced in the southwestern Missouri region, which usually contain a higher lead content, are sold mainly on bids from purchasers, and the values for those concentrates are not comparable with values given for concentrates of the disseminated-lead district.

Analyses of ores mined in the disseminated-lead district in southeastern Missouri and of the various grades of resulting concentrates are given in Mineral Resources for 1919 and 1920.

No shipments of zinc carbonate from southeastern Missouri were reported in 1929, and the only sphalerite shipped was that from the flotation plants of the St. Joseph Lead Co. The new Desloge plant will probably increase its output of zinc in 1930. The average zinc content of the sphalerite concentrates shipped in 1929 was more than 58 per cent and the average silver content was from 15 to 20 ounces to the ton. A detailed average assay of the sphalerite concentrates shipped in 1927 is as follows: Zinc, 57.5 per cent; copper, 0.1 per cent; iron, 2 per cent; calcium oxide, 1.3 per cent; magnesium oxide, 1 per cent; sulphur, 32 per cent; lead, 3 per cent; cadmium, 1 per cent; carbon dioxide, 2 per cent; and silver, 20 ounces a ton.

Only 129 tons of galena concentrates were shipped in 1929 by operators of shallow diggings. Most of it was shipped to smelters by T. F. Blount, of Potosi, and by lessees of the Washington Land & Mining Co. The Conqueror Lead Co. shipped about 500 tons of galena. All the rest of the galena concentrates was produced by the Annapolis Lead Co., the Desloge Consolidated Lead Co., the National Lead Co. (St. Louis), and the St. Joseph Lead Co.

The small quantity of copper was derived from the treatment of copper-lead matte, as no copper ore was shipped in 1929.

The Desloge Consolidated Lead Co. operated four shafts until May, 1929, when the property was acquired by the St. Joseph Lead Co. The mill, equipped with jig table and flotation, has a capacity of 2,000 tons of crude ore daily and produced both lead and zinc concentrates in 1929.

The Annapolis Lead Co. in Iron County worked its mine and mill steadily in 1929, obtaining about one-third of its concentrates from the flotation machines.

The Conqueror Lead Co. did some drilling at the old Katherine mine while operating its 300-ton mill on old tailings. It is reported that operations were suspended early in 1930.

In 1929 the St. Joseph Lead Co., from mines other than the Desloge in southeastern Missouri, treated about 4,477,000 tons of ore, which yielded a good recovery of galena concentrates and sphalerite concentrates. The company operated five concentrating plants ranging in capacity from 1,000 to 5,000 tons daily. All plants are equipped with Wilfley and Butchart tables and flotation machines. The 18 shafts in operation, only 5 of which were used for hoisting ore, ranged in depth from 200 to 500 feet.

The National Lead Co. (St. Louis Smelting & Refining Co.) operated five shafts (average depth, 525 feet) and a concentrating plant (capacity, 3,500 tons) equipped with flotation machines.

Considerable drilling was done in southeastern Missouri in 1929 but the shippers of galena in 1930 will be the St. Joseph Lead Co., the St. Louis Smelting & Refining Co., and the Annapolis Lead Co.

OKLAHOMA

By J. P. Dunlop

Mine shipments of lead and zinc in Oklahoma in 1929, by districts

District	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Miami	59,086	$4,938,790	334,863	$12,907,867	45,046	$5,675,796	172,140	$22,722,480
Quapaw and Sunnyside	1,955	164,839	39,214	1,519,095	1,467	184,842	19,902	2,627,064
	61,041	5,103,629	374,077	14,426,962	46,513	5,860,638	192,042	25,349,544
Total, 1928	56,839	4,591,975	354,071	12,852,797	43,687	5,067,692	180,252	21,990,744

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[1] In calculating the metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades

Tenor of lead and zinc ore, old tailings, and slimes milled and concentrates produced in Oklahoma, 1928 and 1929

	1928		1929	
	Crude ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Total ore, etc., milled ... short tons	5, 527, 700	2, 500, 300	6, 408, 400	2, 916, 200
Total concentrates recovered:				
Galena ... do	56, 449	390	50, 666	375
Sphalerite ... do	315, 717	38, 354	340, 380	45, 697
Ratio of concentrates to ore, etc.:				
Lead ... per cent	0. 87	0. 01	0. 78	0. 01
Zinc ... do	5. 55	1. 53	5. 31	1. 52
Metal content of ore, etc.:				
Lead ... do	0. 69	0. 01	0. 62	0. 01
Zinc ... do	3. 21	0. 88	3. 11	0. 85
Average lead content of galena concentrates ... do	78. 5	66. 2	77. 8	65. 3
Average zinc content of sphalerite concentrates ... do	57. 9	57. 1	58. 6	56. 3
Average value per ton:				
Galena concentrates	$80. 87	$68. 25	$83. 72	$66. 45
Sphalerite concentrates	$36. 72	$33. 39	$39. 02	$35. 34

The following table gives the output of lead and zinc ore, old tailings, etc., for Oklahoma from 1926 to 1929.

Tenor of lead and zinc ore, old tailings, and slimes milled and concentrates produced in Oklahoma, 1926–1929

	1926	1927	1928	1929
Total ore, old tailings, and slimes milled in Oklahoma ... short tons	10, 934, 000	9, 932, 400	8, 028, 000	9, 324, 600
Total concentrates in ore, etc.:				
Lead ... per cent	0. 86	0. 68	0. 61	0. 55
Zinc ... do	4. 95	4. 07	4. 30	4. 14
Metal content of ore, etc.:				
Lead ... do	0. 65	0. 53	0. 68	0. 42
Zinc ... do	2. 83	2. 36	2. 49	2. 42
Average lead content of galena concentrates ... do	78. 5	78. 2	78. 4	77. 8
Average zinc content of sphalerite concentrates ... do	58. 1	58. 1	57. 8	58. 3
Average value per ton:				
Galena concentrates	$106. 95	$86. 77	$80. 79	$83. 61
Sphalerite concentrates	$45. 91	$38. 29	$36. 30	$38. 57

Mine production of lead and zinc concentrates in Oklahoma, 1891–1929, by districts

District	Lead concentrates (mainly galena)		Zinc concentrates			
			Sphalerite		Zinc silicate and carbonate	
	Short tons	Value	Short tons	Value	Short tons	Value
Davis			558	$27, 399	899	$24, 592
Miami	977, 327	$87, 212, 647	5, 018, 849	213, 680, 194		
Peoria	2, 206	109, 163	220	8, 289	2, 944	76, 787
Quapaw and Sunnyside	24, 203	2, 199, 855	201, 565	8, 577, 219	164	2, 692
	1, 003, 736	89, 521, 665	5, 221, 192	222, 293, 101	4, 007	104, 071

Mineral Resources for 1914 contains a brief history of mining in the districts in Oklahoma, also the estimated total production of each district by years.

The total quantity of lead and zinc concentrates shipped from Oklahoma in 1929 was 6 per cent more than in 1928, and the total value was 12 per cent more. The total value of the zinc concentrates in 1929 was greater than the value of any one year's production of any other State.

The lead and zinc deposits of northeastern Oklahoma, so far as known, are confined to Ottawa County and form the southwestern extension of the deposits in the Joplin region. There are three camps—Peoria, Quapaw-Sunnyside, and Miami—in which extensive mining has been done, and a fourth, the Sycamore Creek district, along the Seneca fault block 2 to 3 miles southwest of Seneca, Mo., in which considerable prospecting has been done and some ore mined. The lead and zinc deposits in southern Oklahoma are near Ravia, at the southeast end of the Arbuckle Mountains, and near Davis, Murray County, at the northwest end of the same range.

The quantity of ore and old tailings milled in Oklahoma increased 1,296,600 tons in 1929. The total quantity milled at mines near Quapaw and Sunnyside (all mills at Commerce were idle) was 6 per cent, compared with 5 per cent in 1928. The value of the lead and zinc shipped from mines in Oklahoma in 1929 was $31,210,182, compared with $27,058,436 in 1928. The lead from concentrates sold increased from 43,687 to 46,513 tons, and the zinc from 180,252 to 192,042 tons.

The average lead content of the galena concentrates shipped was 78.4 per cent in 1928 and 77.8 per cent in 1929. The average metal content of the sphalerite concentrates shipped was 57.8 per cent in 1928 and 58.3 per cent in 1929.

Oklahoma produced 63 per cent of the total output of both lead and zinc concentrates from the Joplin region in 1929. The Oklahoma shipments of sphalerite increased 20,006 tons.

A history of the mining in the Miami district, including the output by years for 1908 to 1914 and the location of the mines and mills, was given in Mineral Resources for 1914. The reports for 1915 to 1928 contain full reviews of the production, new territory prospected, new mines opened, and new mills erected in those years. A brief description of the ore deposits in the Miami district is given in Mineral Resources for 1915.[4]

In 1929 about 120 mills in the Oklahoma part of the Joplin or tri-State region shipped 61,041 tons of galena concentrates and 374,077 tons of sphalerite concentrates. The average value of the galena concentrates increased $2.82 a ton, and the average value of the sphalerite concentrates, of which the quantity was more than six times that of the galena shipped, increased $2.27 a ton.

The significant features of the year were the long period (31 weeks) during which the quoted price of sphalerite concentrates remained at $44 a ton and the boom in the price of galena concentrates which resulted in cutting the stocks in mine bins about 10,000 tons.

Efforts were again made to curtail the output of sphalerite to the requirements of retort smelters. The effort met with reasonable success until the fall of the year, when the low base price of $35 a ton resulted in a rapid accumulation of concentrates, so that the net result was larger stocks of sphalerite at mines on December 31, 1929, than on January 1, 1929.

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[4] Siebenthal, C. E., Zinc: Mineral Resources of the United States, 1915, Part I, pp. 888–890.

All of the larger mills are now equipped with flotation units, and the output from this source in 1929 in Oklahoma was 3,200 tons of galena and 87,000 tons of sphalerite. About 5 per cent of the total output of galena and 23 per cent of the sphalerite were flotation products. Most of the mixed flotation and jig and table product was cleared from bins in 1929 and none was being made at the end of the year. The quantity of old slimes and tailings treated increased from 2,500,300 tons in 1928 to 2,916,200 tons in 1929. The percentage of recovery of sphalerite in concentrates from tailings was about the same in 1929 as in 1928. The average assay of the sphalerite concentrates from tailings decreased from 57.1 per cent in 1928 to 56.3 in 1929. The treatment of tailings during the last two years shows that the tailings, regardless of the richness of the original crude ore, contain little recoverable galena, and that the galena recovered at most tailing mills is a low-grade product. The galena from this source averaged 65.3 per cent lead in 1929 and sold for an average price of $66.45 a ton.

A considerable number of mills were improved, but only a few new mills were projected or built. Flotation machines, ball mills, and conveyors were the main items of improvements; mine development was cut to a minimum. The number of drill rigs in operation was less than 50 per cent of the number in operation in 1928. Labor was abundant, and there was often an oversupply. Costs at many mines were reduced, but operators are realizing that much of the cost reduction in the future must come from the operation of larger units on double shift instead of single shift.

The total quantity of ore and tailings milled in the Miami part of the Joplin region in Oklahoma and Kansas in 1929 was 13,823,200 tons and the shipments were 91,087 tons of galena concentrates and 562,371 tons of sphalerite concentrates. Of these concentrates, 5,200 tons of galena and 134,000 tons of sphalerite were flotation products. Each of 106 mines in this region made shipments of galena and sphalerite concentrates exceeding $100,000 in value. More shafts and milling plants are grouped in this area than in any other area in the United States. Some of the sphalerite recovered by flotation assayed over 60 per cent of zinc and some as low as 45 per cent, but the great bulk assayed 55 to 58 per cent. Few mines in the Miami field were definitely abandoned in 1929, but a number were cleaning up and pulling pillars, and some mills were operating partly on crude ore and partly on tailings. Operators having an ample supply of crude ore are conserving it and utilizing their mills to rerun old tailings.

The quantity of ore, old tailings, and slimes milled in Oklahoma increased from 8,028,000 tons in 1928 to 9,324,600 tons in 1929. The average zinc content of the sphalerite was 58.3 per cent in 1929. The separate assays reported in 1929 showed a range in zinc content from 40 to 62 per cent, but most of the sphalerite assayed between 57 and 59 per cent. An assay of a composite sample of 6,850 lots of concentrates shipped in 1929 from the Miami region in Oklahoma and Kansas, made by Waring & Williams, showed an average content of 58.2 per cent of zinc, 1.65 per cent of iron, 0.70 per cent of lead, and 0.39 per cent of cadmium; the average zinc assay, as computed from the reports of all the companies selling concentrates, was about 58.3 per cent.

The total recovery of concentrates from Oklahoma mines averaged 1 ton of galena to 7 tons of sphalerite. The proportion of galena concentrates recovered from crude ore from various mines ranged from no galena recovered to as high as 4½ tons of galena to 1 ton of sphalerite.

The total shipments from those properties that may be classed as in the Cardin-Douthat area amounted to 33,683 tons of galena and 179,711 tons of sphalerite, a decrease of 6,079 tons compared with 1928. About 4,417,900 tons of ore and old tailings were treated, and the recovery in concentrates averaged about 0.70 per cent for galena and 4.2 per cent for sphalerite. The ratio of galena to sphalerite recovered at all mines in the vicinity of Douthat was 1 ton of galena to about 12 tons of sphalerite; in the Cardin section it was 1 ton of galena to about 42.2 tons of sphalerite; and in the Picher area 1 ton of galena to about 4.5 tons of sphalerite.

The territory east of Picher near the Hockerville and Zincville camps was more productive than in 1928, when the shipments from 16 mines and 3 tailing mills were 6,749 tons of galena and 60,006 tons of sphalerite; in 1929 the shipments from 12 mines and 3 tailing mills were 6,053 tons of galena and 62,874 tons of sphalerite from 976,900 tons of ore and 359,700 tons of old tailings and slimes treated.

The production of the mines near Picher increased. In 1928 the quantity of ore and old tailings milled was 2,261,000 tons, and the shipments were 15,705 tons of galena and 77,695 tons of sphalerite. In 1929 the quantity of ore and old tailings milled was 3,010,700 tons, and the shipments were 19,288 tons of galena and 92,249 tons of sphalerite. The quantity of tailings milled in 1929 was 1,106,500 tons, compared with 910,700 tons in 1928. The average zinc content of the sphalerite was 57.6 per cent, and the lead content of the galena was 78.2 per cent.

At Commerce (old Hattenville) none of the old mines was operated in 1929, and the galena and sphalerite shipped was from a mill clean-up.

No shipments were reported from Peoria in 1929. This camp was the first zinc-producing area in Oklahoma and practically no work has been done at any mine during the last two years.

Near Hockerville and Zincville.—The Brewster mine, one of the oldest in the district, was again the largest producer in this area. Other leading producers were the Canadian, Crane, Dorothy Bill, Duluth, Good Luck, Huttig No. 1 (now Eleventh Hour), Imbau, Lucky Jenny, Retriever (tailings), Semple (tailings), Texas, and Weiss. The Toltec mine was sold to the Massell Mining Co., and a mill at the Wade mine was reconstructed at the Toltec and was producing early in 1930. The Texas mine, called the "Advance Mine," was operated in 1929 and was then sold to the Columbus Mining & Milling Co. The Wade and Mary Ann mines were only operated a few days in 1929, and their output was nominal. The Santa Fe mine had a good output after it was purchased by the Good Luck Mining Co.

Near Quapaw and Sunnyside.—In this area about 503,500 tons of ore and 55,900 tons of old tailings were milled in 1929, yielding 1,955 tons of galena concentrates and 39,214 tons of sphalerite concentrates. Three mines of the Century Zinc Co. produced about 90 per cent of the galena and 60 per cent of the sphalerite. Most of the remainder was the output of the John L. Mining Co. (Donna Jane and Patty C.) and the Tulsa Lead & Zinc Co. The Davenport and other mines of the Federal Mining & Smelting Co. in this area were idle in 1929. The Hobart mine, owned by the Ilhawa Mining Co., and the Rainbow mine of the Hanenkratt Lead & Zinc Co. were idle most of the year. The old Bendene mine was operated part of 1929 by the Louis W. Mining Co., and the Diamond Joe mine and mill were operated spasmodically. The Buckeye mine at the southern end of the camp rebuilt a 150-ton mill and ran on ore from the 100-foot level for several months. The Tulsa Lead & Zinc Co. mill ran partly on ore and partly on old tailings. The Martha B. mine was idle all year and has been sold to the White McKay Mining Co.

Near Century and Douthat.—More than 55 per cent of the sphalerite concentrates shipped from properties in this area was sold by the Admiralty Zinc Co. and the Skelton Lead & Zinc Co., and more than 60 per cent of the galena concentrates was shipped by the New Chicago Mines Corporation and the Skelton Lead & Zinc Co. Other producing properties were the Canam Metals Corporation, Consolidated Lead & Zinc Co., and Ramage Mining Co. Tailing mills active in 1929 were the California Milling Co., the Glendale Milling Co., and the Moyer Milling Co. Old tailings were also run at New Chicago and Skelton mills. The quantity of old tailings and slimes reported as treated in 1929 was 451,800 tons, and the recovery was 6,839 tons of sphalerite.

Near Cardin and Tar River.—This area in the Miami field had the largest shipments of concentrates in 1929. The leading shippers were the Adams Mining Co. (1 mill), Commerce Mining & Royalty Co. (7 mills), Consolidated Lead & Zinc Co. (3 mills), Evans Wallower Lead Co. (2 mills), Interstate Zinc & Lead Co., Kansas Explorations (Inc.), Rialto Mining Corporation, and Velie Mine Corporation. Other producers were the American Zinc Co. of Oklahoma, Crystal Mineral Trust, Federal Mining & Smelting Co., L. & G. Mining Co., and Pioneer Lead & Zinc Co.

Old tailings were run at the O. M. Bilharz Mining Co., Childress & Heggen Mining Co., Commerce Mining & Royalty Co. (Gosling and Standard), Consolidated Lead & Zinc Co. (No. 13), Kansas Explorations (Inc.) (Ritz), L. & G. Mining Co., and Vinegar Hill Zinc Co. (Wilson).

The total quantity of slimes and old tailings treated in 1929 was 942,300 tons, and the production of concentrates from this source was 216 tons of galena, averaging 65 per cent of lead, and 14,291 tons of sphalerite, averaging about 57 per cent of zinc. The quantity of tailings treated in 1929 was about 200,000 tons less than in 1928, and the recovery of concentrates was about 3,000 tons less than in 1928. The Canam Metals Corporation operated the Foch and the Southside mines part of the year; it also ran the Tri State mine for a few weeks before giving up the option to purchase. Tiger No. 2 mine, one of the largest lead-producing mines in the district, has been sold by the Canam Metals Corporation to the Mary M. Mining Co. The four leases which are to supply ore for the new 1,000-ton Bird Dog mill of the Commerce Mining & Royalty Co. were fully developed in 1929, and the surface plants were completed early in 1930.

Near Picher.—The quantity of ore milled and the concentrates recovered from the area about Picher, which includes many of the older and steadiest operated mines of the Miami district, were considerably more than in 1928, and the quantity of old tailings treated increased about 200,000 tons. The largest shippers in 1929 were the American Zinc Co. of Oklahoma, Canam Metals Corporation (2 mills), Commerce Mining & Royalty Co., Commonwealth Mining Co., Consolidated Lead & Zinc Co. (3 mills), Cortez King Brand Mining Co. (3 mills), Eagle Picher Lead Co. (5 mills), Federal Mining & Smelting Co., Howe Mining Co., Jeff City Mining Co., New Chicago Mines Corporation, Oko Mine, and Tri State Zinc Co. Other producers were the Acme Mining Co., Birthday Mining Co., Golden Hawk Mining Co., Just Right Milling Co., St. Louis Smelting & Refining Co. (No. 6), and C. W. Theurer.

Old tailings only were treated by the Commonwealth Mining Co., Just Right Milling Co., De Mier-King Milling Co., Retriever Milling Co. (Hunt), Roberts Milling Co., Oko Mine, and C. W. Theurer (Black Eagle), and most of the concentrates made by the New Chicago Mines Corporation at the Vantage and Premier mills were derived from tailings.

The estimated quantity of old tailings re-treated was 1,106,500 tons, from which 107 tons of galena concentrates and 14,195 tons of sphalerite concentrates (55.4 per cent zinc) were recovered. Mills treating ore (1,904,200 tons) shipped 19,181 tons of galena concentrates and 78,054 tons of sphalerite concentrates.

The old Acme mine was sold by C. C. Cole to a new corporation, the Acme Mining Co. The Black Hawk and Golden Hawk mines were purchased and operated in 1929 by the Canam Metals Corporation.

WISCONSIN

By J. P. Dunlop

Mine production of lead and zinc in Wisconsin in 1929, by districts

District	Lead concentrates		Zinc concentrates				Metal content[1]			
			Sphalerite		Silicate and carbonate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Benton-New Diggings	18	$1,870	5,033	$77,175	------	------	14	$1,764	1,240	$163,680
Cuba City and Hazel Green	173	13,960	19,610	373,818	------	------	127	16,002	5,015	661,980
Dodgeville	375	28,850	2,415	64,060	------	------	269	33,894	882	116,424
Highland	17	800	------	------	161	$3,970	11	1,386	57	7,524
Linden and Platteville	122	10,461	3,437	79,017	------	------	86	10,836	1,191	157,212
Shullsburg	1,465	114,647	39,234	610,977	------	------	1,029	129,654	8,601	1,135,332
	2,170	170,588	69,729	1,205,047	161	3,970	1,536	193,536	16,986	2,242,152
Total, 1928	2,414	176,951	71,710	1,245,884	488	7,767	1,698	196,968	18,417	2,246,874

[1] In calculating the metal content of the ores from assays allowance has been made for roasting and smelting losses of both lead and zinc. In comparing the values of ore and metals it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and concentrates produced in Wisconsin, 1926–1929

	1926	1927	1928	1929
Total ore..........short tons..	1,440,300	1,480,800	733,500	607,100
Total concentrates in ore:				
Lead..........per cent..	0.16	0.20	0.33	0.36
Zinc..........do....	7.03	8.83	9.84	11.5
Metal content of ore:				
Lead..........do....	0.13	0.14	0.23	0.26
Zinc..........do....	2.38	2.79	3.26	3.53
Average lead content of galena concentrates..........do....	67.2	72.4	71.7	72.2
Average zinc content of sphalerite concentrates..........do....	33.8	31.6	33.1	30.6
Average zinc content of zinc carbonate concentrates..do....	32.3	32.7	34.0	41.6
Average value per ton:				
Galena concentrates..........	$93.02	$81.46	$73.30	$76.61
Sphalerite concentrates..........	$21.89	$17.22	$17.37	$17.28
Zinc carbonate concentrates..........	$25.05	$17.85	$15.92	$24.60

The lead and zinc mines of Wisconsin are in Grant, Iowa, and Lafayette Counties and contain the most valuable part of the ore deposits of the upper Mississippi Valley region, a historical review of which is given in the Illinois section of the report of this series in Mineral Resources for 1914. A detailed description of the Wisconsin lead and zinc districts and of the mines in each district to the year 1906 is given by Bain.[5] The development of the mines subsequent to Bain's report and the output of Wisconsin mines have been set forth in Mineral Resources since 1906.

Roasting and electromagnetic separation have been utilized in the district for many years to produce a marketable zinc product. Comparatively few of the concentrating plants are equipped with roasters, but the larger mining interests own or control separating plants[6] and nearly all of the raw concentrates were roasted.

The only roasting and separating plant operated in Wisconsin in 1929 was the National Zinc Separating Co. at Cuba City. The Mineral Point Zinc Co.'s plant at Mineral Point was idle. The shipments of concentrates came from about 20 mines, many of which were small. Only a few thousand tons of tailings were re-treated in 1929, and the material milled decreased more than 126,000 tons.

The total value of the mine output of lead and zinc in Wisconsin in 1929 was $2,435,688, compared with $2,443,842 in 1928. The quantity of lead concentrates sold decreased from 2,414 tons in 1928 to 2,170 tons in 1929, and the quantity of sphalerite concentrates decreased from 71,710 to 69,729 tons. The quantity of lead from galena concentrates was 162 tons less than in 1928, and the quantity of zinc from sphalerite and zinc carbonate concentrates decreased 1,431 tons.

About 66 per cent of the galena and 80 per cent of the sphalerite shipped were the output of the Vinegar Hill Zinc Co., although about 7 mills were operated by other companies. Not much development was reported, but some drilling was done and new bodies of ore located.

The metal content of the raw sphalerite concentrates shipped in 1929 ranged from 25 to 50 per cent. Thirty-four per cent of the sphalerite ranged between 30 and 38 per cent zinc content, and 52 per cent of the total shipments averaged less than 29 per cent. The zinc content of the roasted sphalerite concentrates shipped was 57 to 58 per cent.

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[5] Bain, H. F., Zinc and Lead Deposits of the Upper Mississippi Valley: U. S. Geol. Survey Bull. 294, 1906, pp. 81–148.

[6] Deutman, E. G., The Roasting and Magnetic Separation of Wisconsin Zinc Ores: Eng. and Min Jour., June 28, 1919, pp. 1107–1111.

The crude ore yields a high recovery in concentrates, frequently 12 to 20 per cent, but the sphalerite concentrates shipped had a much lower zinc content than those of other Central States. The shipments of sphalerite decreased slightly (about 2,000 tons), and the zinc content was less than in 1928. Of the total shipments of sphalerite in 1929, probably less than 2,000 tons went direct to retort zinc plants; the remainder went to the National Zinc Separating Co.'s plant at Cuba City. The only zinc carbonate shipments (161 tons) were purchased by the Mineral Point Zinc Co. at Mineral Point. The shipments of zinc carbonate in 1928 were 488 tons.

The total shipments in 1929 from mines in the upper Mississippi Valley region (Illinois and Wisconsin) amounted to 70,002 tons of sphalerite, 161 tons of zinc carbonate, and 2,170 tons of galena. The average zinc content of the raw sphalerite concentrates from Wisconsin in 1929 was 30.6 per cent and the average value per ton was $17.28, compared with 33.1 per cent and $17.37 in 1928. Mines in the Shullsburg district produced 67 per cent of the galena and 56 per cent of the sphalerite in 1929.

The Vinegar Hill Zinc Co. worked the Birkett mine at Hazel Green and the Badger, Mullen, and James mines near Shullsburg. A new 250-ton mill which was operated after November, 1929, was equipped at the Badger mine. Other large shippers of concentrates in 1929 were the Badger Zinc Co. (Rule mine) at Linden, the Blockhouse at Platteville, the Ellis (Badger Zinc Co.), the Lucky Five at Dodgeville, and the Ida Blende at Benton. Other shippers were Edward Dare on the Martin land at Benton, who plans to install a new mill in 1930, C. Fox, George Baker, and G. C. Potter. The Paris Hill Mining Co. continued its development of the McCabe land at Benton.

SECONDARY METALS [1]

By J. P. Dunlop [2]

INTRODUCTION

SCOPE OF REPORT

"Secondary metals" are those recovered from scrap metal, sweepings, skimmings, and drosses and are so called to distinguish them from metals derived directly from ores, which are termed "primary metals." The distinction does not imply that secondary metals are of inferior quality, for metals derived either from ore or from waste material vary in purity and in adaptability to use in making certain products. The figures furnished by producers cover seven metals—secondary copper, zinc, lead, tin, antimony, aluminum, and nickel—and supplement those on the primary metals. They are given to enable producers and consumers to form a more comprehensive idea of the quantities of metal available for consumption; in fact, they constitute an essential addition to the figures given in the general reports on the primary metals and will become more essential in the future.

"Secondary metal" was very aptly defined at the February, 1928, meeting of the American Institute of Mining and Metallurgical Engineers "as that which had lost its original identity as to source."

RECOVERY, TREATMENT, AND USE OF WASTE MATERIAL

The collection of waste material is a long-established branch of industry now vital as an important source of supply of many products. It involves the collection, sorting, and shipment of waste having an estimated value exceeding a billion dollars a year. This report covers less than one-third of the value and only a small percentage of the total quantity of waste materials that are marketed. There is an imposing variety of wastes, and these wastes are segregated into many classes so as to make them available for different uses. Perusal of trade papers devoted to waste material discloses an active trade by buyers and sellers of hundreds of different wastes. In fact there appears to be a use for nearly all waste material salable at a price that will meet the expenses of collection, conditioning, and marketing. A large part of the wastes in rural sections can not be, and is not, collected, as the cost of collecting and the freight to points of consumption are more than the gross cash return. On the other hand, large producers of waste have increased their recoveries as a prominent factor of economical operation. The modern manufacturer does not like accumulations of litter; he is orderly and realizes that neatness pays, and also that prompt segregation and preparation of waste are profitable and necessary. The use and disposal of waste products at many large plants are as carefully planned as the purchase and sale of primary materials This explains why a larger proportion of the waste returned to commercial channels originates in manufacturing plants and why a smaller proportion is derived from country collections and shipments.

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[1] Work on manuscript completed November, 1930.

[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

An interesting development in the secondary metals industries has been the growth of trade associations. Such organizations have greatly enlarged the scope of their activities, particularly in urging their members to conform to a more rigid code of ethics. As an example of the latter, the code of ethics drawn up by the Non-Ferrous Ingot Metal Institute is given below.

1. It is the judgment of the industry that a knowledge of cost is indispensable to intelligent competition, and the general adoption of uniform methods of cost accounting is recommended by the industry.

2. The defamation of a competitor in any manner, either by imputing to him dishonorable conduct, inability to perform contracts or questionable credit standing or a false disparagement of the grade or quality of his goods, or otherwise, is an unfair trade practice.

3. The making, causing, or permitting to be made or published any false, untrue, or deceptive statement by way of advertisement, or otherwise, concerning grade, quality, character, nature, origin, manufacture, or preparation of products is an unfair trade practice.

4. The imitation of the trade-marks or trade names of a competitor results in deception to buyers and consumers, and is an unfair trade practice.

5. Interference with a competitor's business through the enticement of his employees from his employment is an unfair trade practice.

6. That the enticing or attempting to entice away the customers of any competing manufacturer of ingot brass and/or bronze by offering said customers special and unusual discounts on purchases, postdating invoices, and accepting long-term notes in payment for goods, when the said advantages are not offered to all alike, is condemned by the industry.

7. Wilfully inducing or attempting to induce the breach of an existing contract by any means or device whatsoever, or interfering with or obstructing the performance of any contractual duty or service connected therewith, such breach or interference being for the purpose or with the effect of deceiving, destroying, or appropriating, in whole or in part, the patronage, property, or business of another engaged in the industry, is hereby declared an unfair trade practice.

8. That all ingot brass and/or bronze should be sold by grade or specification, and that the making of lump-sum prices to cover the sale of two or more separate grades or kinds of merchandise prevents the purchasing trade from knowing the prices for said separate grades or specifications, and is condemned by the industry.

9. The sale of ingot brass and/or bronze conditioned upon the sale of any other commodity or manufactured article on which rebates, special prices, or other concessions are allowed, when the same advantages are not extended to all customers alike, is condemned by the industry.

10. The giving of cash discounts or terms of net payment in excess of the usual and customary practice prevailing in the industry is condemned by the industry.

11. Contracts of sale which permit the buyer to cancel or provide for a reduced price in the event of a market decline but which do not permit the seller to cancel or provide for an enhanced price in the event of a market rise, are lacking in mutuality, and are condemned by the industry.

12. Directly or indirectly to give or permit to be given or promising to give to the agents, employees, or representatives of customers or prospective customers, or the agents, employees, or representatives of competitors' customers or prospective customers, without the knowledge of his employer, money or anything of value, as an inducement to cause employers or principals to purchase

or contract to purchase ingot brass and/or bronze, or to influence such employers or principals to refrain from dealing or contracting to deal with competitors is an unfair trade practice.

13. The false marking or branding of products, for the purpose and with the effect of misleading or deceiving purchasers with respect to the quantity, quality, grade, or substance of the goods purchased, is an unfair trade practice.

14. That any contract or other form of order postdated or predated except to conform to a bona fide agreement for the purchase or sale of ingot brass and/or bronze on a predate, is hereby condemned by the industry.

15. The sale of an inferior quality of ingot brass and/or bronze at a price appropriate for such merchandise, and the delivery on such order of a superior quality of merchandise, selling at a higher price, is condemned by the industry.

16. The shipment or delivery of ingot brass and/or bronze not reasonably conforming to the specifications or samples submitted or representations made prior to securing the order, when done for the purpose and with the effect of deceiving the customer, is an unfair trade practice.

17. All smelters of ingot brass and/or bronze should sell their finished merchandise on the basis of f. o. b. destination. Railroad business may be excepted.

18. Selling ingot brass and/or bronze below cost for the purpose of injuring a competitor, or with the effect of lessening competition, is an unfair trade practice.

19. The acceptance of an order without a reasonable time limit for delivery and/or the acceptance of an order confirming delivery beyond such reasonable time, is a poor business practice, and is condemned by the industry.

20. (*a*) Withholding from or inserting in an order or invoice statements which make the order or invoice a false record, wholly or in part, of the transaction represented on the face thereof, is condemned by the industry.

(*b*) The secret payment or allowance of rebates, refunds, credits, unearned discounts, whether in the form of money or otherwise, or the secret extension to certain purchasers of concessions, services, or privileges not extended to all purchasers under like conditions, is an unfair trade practice.

21. It is the judgment of the ingot brass and bronze industry that inasmuch as the manufacturers of ingot brass and bronze pay for their labor and raw materials on a cash basis, the giving or the allowing of any unreasonable discount or unreasonable time for net payment, is condemned by the industry.

22. (*a*) The industry approves the practice of each individual member of the industry independently publishing and circulating to the purchasing trade his own price lists, and condemns any practice of publishing fictitious prices or prices not representative of the true prices of such manufacturer.

(*b*) The industry records its approval of the practice of making the terms of sale a part of any published price schedule.

23. By custom long established, the basic prices for ingot brass and bronze have been calculated on the basis of one or more carloads of minimum weight, and the making of prices for less-than-carload orders of ingot brass and/or bronze which do not recognize the proper differential existing in the trade for less-than-carload lots, is condemned by the industry.

24. (*a*) The making of contracts which do not expressly cover quantity, specifications, time limit for delivery, and other items necessary to form a complete, unambiguous contract, often results in price discrimination, induces fraud, breach of contract, and constant disputes, and is condemned by the industry.

(*b*) It is recommended by the industry that a standard form of contract which will avoid ambiguity, prevent misunderstandings, and thoroughly protect the rights of both buyers and sellers be adopted.

25. Economical practice demands the manufacture and sale of ingot brass and/or bronze of commercially acceptable grades, and the acceptance of an order calling for specifications that are not within the limits of the generally recognized commercial grades at a price which does not properly reflect the additional cost of raw materials, labor, and supervision is condemned by the industry.

26. The making of false reports of capacity, production, as well as orders, purchases, or shipments, is condemned by the industry.

27. A Committee on Trade Practices is hereby created and empowered to investigate and determine whether these resolutions are being observed, to make complaints concerning alleged violations, to cooperate with the Federal Trade Commission, and generally to perform such other acts as may be reasonably necessary and proper to put these resolutions into effect and accomplish the objects and purposes of this conference.

The Institute of White Metals, an organization including members of custom smelters and manufacturers of white metals, was formed in March, 1930, to carry on cooperative activities in the best interests of its members. The Institute of Scrap Iron and Steel (Inc.) has expanded its activities and increased the number of its chapters until the following areas are represented: Boston, Buffalo, Chicago, Cincinnati, Cleveland-Detroit, New Jersey, New York, Northwest, Pacific coast, Philadelphia, Pittsburgh, Reading, and St. Louis. It is very active in correcting trade abuses, in settling disputes, and in promoting efforts for freight readjustments. Its expressed hopes are to bring general prosperity to the scrap iron and steel industry and also to supply comprehensive data relating to the quantity and classes of the commodities handled by its members. Most of the secondary metals recovered are treated in the territory east of Mississippi River and north of Ohio River, although a slowly increasing quantity is treated in other areas. An interesting series of articles on recoveries in the Pittsburgh (Pa.) district has been published.[3] Other articles of interest relating to secondary metals are:

Darling, E. R., Nonferrous Secondary Metals: Min. and Met., January, 1930, p. 9.

Flynn, F. N., Reclaiming Nonferrous Scrap at Manufacturing Plants: Am. Inst. Min. and Met. Eng. Tech. Paper 233, 1929.

Clamer, G. H., Development and Future of the Nonferrous Ingot Industry: Metal Ind., April, 1929, pp. 178–180.

The earlier chapters on Secondary Metals in Mineral Resources contain much information regarding the collection of waste material and many references to articles published about smelting and refining nonferrous waste. Various trade papers, such as the Waste Trade Journal, Daily Metal Trade, Brass World, American Metal Market, Foundry, Iron Age, Iron Trade Review, Metal Industry, Salvage, National Waste Review, Metal and Mineral Markets, and Daily Metal Reporter, also contain valuable information relating to prices and marketing of scrap metal and drosses and technical information relating to the proper use of old metals.[4]

CLASSIFICATION OF OLD METALS

The classification of old metals drawn up by the metal division of the National Association of Waste Material Dealers (Inc.) (Times Building, New York, N. Y.) and changed from time to time as desirable is the standard of both dealers and manufacturers in the United States. The latest classification (Circular L), effective March 13, 1930, follows; attention is directed to items 19, 26, and 35, which show changes in the specifications relating to auto radiators, lead battery plates, and Babbitt metal.

Standard Classification for Old Metals, Effective from March 13, 1930

1. *Delivery.*—(*a*) Delivery of more or less of the specified quantity up to 2½ per cent is permissible.

(*b*) If the term "about" is used, it is understood that 5 per cent more or less of the quantity may be delivered.

(*c*) Should the seller fail to make deliveries as specified in the contract, the purchaser has the option of canceling all of the uncompleted deliveries or holding the seller for whatever damages the purchaser may sustain through failure to deliver, and if unable to agree on the amount of damages an arbitration committee of the National Association of Waste Material Dealers (Inc.), appointed for this purpose, to determine the amount of such damages.

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[3] Von Bernewitz, M. W., Salvaging and Treating Non-Ferrous Scrap in the Pittsburgh, Pa., District: Salvage, October, 1929, pp. 9–10; Salvage, November, 1929, pp. 11, 12, 20; Salvage, December, 1929, pp. 9, 11, 28.

[4] Metal Industry, Value of a Business Publication: July, 1926, p. 290.

(*d*) In the event that buyer should claim the goods delivered on a contract are not up to the proper standard, and the seller claims that they are a proper delivery, the dispute shall be referred to an arbitration committee of the National Association of Waste Material Dealers (Inc.), to be appointed for that purpose.

(*e*) A carload, unless otherwise designated, shall consist of the weight governing the minimum carload weight at the lowest carload rate of freight in the territory in which the seller is located. If destination of material requires a greater carload minimum weight, buyer must so specify.

(*f*) A ton shall be understood to be 2,000 pounds unless otherwise specified. On material purchased for direct foreign shipment a ton shall be understood to be a gross ton of 2,240 pounds unless otherwise specified.

(*g*) If, through embargo, a delivery can not be made at the time specified, the contract shall remain valid and shall be completed immediately on the lifting of the embargo, and terms of said contract shall not be changed.

(*g*–1) When shipments for export for which space has been engaged have been delivered or tendered to a steamship for forwarding and through inadequacy of cargo space the steamship can not accept the shipment, or where steamer is delayed in sailing beyond its scheduled time, shipment on the next steamer from the port of shipment shall be deemed a compliance with the contract as to time of shipment.

(*h*) In case of a difference in weight and the seller is not willing to accept buyer's weights, a sworn public weigher shall be employed, and the party most in error must pay the costs of handling and reweighing.

(*i*) When material is such that it may be sorted by hand, consignees can not reject the entire shipment if the percentage of rejection does not exceed 10 per cent. The disposition of the rejected material should then be arranged by negotiations; no replacement of the rejected material to be made.

Upon request of the shipper, rejections shall be returnable to the seller on domestic shipments within one week and on foreign shipments within 30 days from the time notice of rejection is received by them, and upon payment by them of 1 cent a pound on material rejected to cover cost of sorting and packing; the seller to be responsible for freight both ways.

2. *No. 1 copper wire.*—To consist of clean untinned copper wire not smaller than No. 16 B. & S. Wire gauge to be free from burnt copper wire which is brittle and all foreign substances.

3. *No. 2 copper wire.*—To consist of miscellaneous clean copper wire which may contain a percentage of tinned wire and soldered ends but to be free of hair wire and burnt wire which is brittle; the tinned wire not to be over 15 per cent of the total weight.

4. *No. 1 heavy copper.*—This shall consist of copper not less than 1/16 inch thick, and may include trolley wire, heavy field wire, heavy armature wire, that is not tangled, and also new untinned and clean copper clippings and punchings, and copper segments that are clean.

5. *Mixed heavy copper.*—May consist of tinned and untinned copper, consisting of copper clippings, clean copper pipe and tubing, copper wire free of hair wire and burnt and brittle wire, free from nickel-plated material.

6. *Light copper.*—May consist of the bottoms of kettles and boilers, bathtub linings, hair wire, burnt copper wire which is brittle, roofing copper and similar copper, free from radiators, brass, lead and solder connections, readily removable iron, old electrotype shells, and free of excessive paint, tar, and scale.

7. *Composition or red brass.*—May consist of red scrap brass, valves, machinery bearings and other parts of machinery, including miscellaneous castings made of copper, tin, zinc and/or lead, no piece to measure more than 12 inches over any one part or to weigh over 60 pounds, to be free of railroad boxes and other similarly excessively leaded material, cocks and faucets, gates, pot pieces, ingots, and burned brass, aluminum composition, manganese, and iron.

8. *Railroad bearing.*—Shall consist of railroad boxes or car journal bearings, must be old standard used scrap, free of yellow boxes, also iron-backed boxes, and must be free of babbitt, also free of excessive grease and dirt.

9. *Cocks and faucets.*—To be mixed red and yellow brass, free of gas cocks and beer faucets.

10. *Heavy yellow brass.*—May consist of heavy brass castings, rolled brass, rod brass ends, chandelier brass, tubing, not to contain over 15 per cent of tinned and/or nickel-plated material; no piece to measure more than 12 inches over any

one part and must be in pieces not too large for crucibles. Must be free of manganese mixture, condenser tubes, iron, dirt and excessive corroded tubing. Must be free of aluminum brass containing over 0.20 per cent aluminum.

11. *Yellow brass castings.*—Shall consist of brass castings in crucible shape, that is, no piece to measure more than 12 inches over any one part; must be free of manganese mixtures, tinned and nickel-plated material, and must be free of visible aluminum brass.

12. *Light brass.*—May consist of miscellaneous brass, tinned or nickel plated that is too light for heavy brass, to be free of gun shells containing paper, ashes or iron, loaded lamp bases, clock works, and automobile gaskets. Free of visible iron unless otherwise specified.

13. *Old rolled brass.*—May consist exclusively of old pieces of sheet brass and pipe free from solder, tinned and nickel-plated material, iron, paint, and corrosion, ship sheathing, rod brass, condenser tubes, and Muntz metal material.

14. *New brass clippings.*—Shall consist of the cuttings of new sheet brass to be absolutely clean and free from any foreign substances and not to contain more than 10 per cent of clean brass punchings to be not smaller than ¼ inch in diameter.

15. *Brass pipe.*—Shall consist of brass pipe, free of nickel-plated, tinned, soldered, or pipes with cast brass connections. To be sound, clean pipes free of sediment and condenser tubes.

16. *No. 1 red composition turnings.*—To be free of railroad car box turnings and similarly excessively leaded material, aluminum, manganese, and yellow brass turnings; not to contain over 2 per cent free iron; to be free of grindings and foreign material, especially babbitt. Turnings not according to this specification to be sold subject to sample.

17. *No. 1 yellow rod brass turnings.*—Shall consist of strictly rod turnings, free of aluminum, manganese, composition, Tobin and Muntz metal turnings; not to contain over 3 per cent free iron, oil, or other moisture; to be free of grindings and babbitts; to contain not more than 0.30 per cent tin and not more than 0.15 per cent combined iron.

18. *No. 1 yellow brass turnings.*—Shall consist of yellow brass turnings, free of aluminum, manganese, and composition turnings; not to contain over 3 per cent of free iron, oil, or other moisture; to be free of grindings and babbitts. To avoid dispute, to be sold subject to sample.

19. *Auto radiators (unsweated).*—All radiators to be subject to deduction of actual iron. The tonnage specification should cover the gross weight of the radiators.

20. *No. 1 pewter.*—Shall consist of tableware and soda-fountain boxes, but in any case must test 84 per cent tin. Siphon tops to be treated for separately.

21. *Zinc.*—Must consist of clean sheet and cast zinc, also cast batteries to be free of loose oxide and dross, sal ammoniac cans, and other foreign materials.

22. *Zinc dross.*—Must be unsweated in slabs and must contain a minimum of 92 per cent of zinc.

23. *Tin foil.*—Shall consist of pure foil free of lead compositions and other foreign ingredients and matters.

24. *Electrotype shells.*—Must be hand picked and free of loose dross and chunks of dross.

25. *Scrap lead.*—Should be clean, soft scrap lead.

26. *Battery lead plates.*—Shall consist of dry battery lead plates, moisture not to exceed 1 per cent, allowance to be made for wood, rubber, and paper and excess moisture, or lead plus antimony content, dry basis, less a treatment charge.

27. *New sheet aluminum clippings and new aluminum wire.*—Shall consist of new sheet aluminum, cuttings, and new aluminum wire. Must be free from oil, grease, and any other foreign substances. Must be guaranteed not less than 98 per cent pure aluminum and not to contain more than 10 per cent of clean aluminum punchings to be not smaller than ¼ inch in diameter.

28. *Old aluminum wire.*—Shall consist of old aluminum wire guaranteed 98 to 99 per cent pure aluminum and must be free from iron cores, insulation, and any other foreign substance.

29. *Alloy sheet aluminum.*—To be sold on specification and sample.

30. *Painted sheet aluminum.*—Shall consist of painted sheet aluminum and must be absolutely free from iron, dirt, or any other foreign substance.

31. *Old sheet aluminum.*—Shall consist of old and manufactured sheet aluminum. Must be free from painted sheet aluminum, iron, dirt, and any other foreign substance.

32. *Aluminum castings.*—Shall consist of aluminum castings, free from iron, babbitt, brass, and any other foreign substance. Must not exceed 2 per cent of oil and grease. Free of pistons.

33. *Aluminum borings.*—To avoid dispute, should be sold subject to sample.

34. *Aluminum foil.*—Shall consist of pure aluminum foil, free from paper and any foreign ingredients.

35. *Babbitt metal.*—Shall contain bearing metal of all kinds. Shall not contain scrap hard metal, Allen metal (which is copper and lead alloy), die cast, ornamental metal, casket metal, zinc boxes, or type metal.

36. *Packages.*—Shall be good strong packages suitable for shipment, and each package shall be plainly marked with separate shipping marks and numbers and with the gross and tare weights, so that the packages may reach their destination and their weights can be easily checked.

There is a growing demand for scrap-metal specialties (not specifically covered by the preceding classification), such as nickel alloys, German silver, Monel metal, cadmium, and molybdenum. Difficulties in making shipments to buyers' specifications have arisen, and with the object of eliminating some of the trouble the Waste Trade Journal has published certain classifications used by one of its advertisers. It is worth while to reproduce those that follow so that they will be available to sellers of some metals and alloys.

Pure nickel clippings.—To consist of sheeting clippings, guaranteed 99 per cent nickel, to be free of solder material and other alloys. If in a state other than clippings, same is to be mentioned.

Pure nickel turnings.—To consist of nickel turnings free of iron or other foreign material.

No. 1 hard nickel anodes.—To consist of hard anodes with all hooks cut off close to the top of the anodes, to be free of soft, crumbly or heavily corroded anodes.

Nickel dust.—To consist of dry material from nickel anodes, to be free of yellow sulphate and dye-house sludge, or other foreign material.

Nickel platers' basket, hooks, racks, etc.—A good packing shall consist of baskets, hooks, racks, etc., made of either brass or copper, and to have a heavy nickel deposit. Baskets, hooks, racks, etc., made of iron, and which have a heavy nickel deposit to be packed separately. To avoid disputes, all plating baskets, hooks, racks, etc., should be sold subject to sample. Light deposited nickel baskets, hooks, racks, etc., shall not be considered good delivery.

Nickel strippings.—To consist of clean, sieved strippings or peelings, free of brass or copper, and other foreign material, and should not contain strippings that have copper layers in them.

New Monel metal clippings.—To consist of new clippings and skeleton scrap, to be free of brazed and soldered material or other metal attachments.

Monel metal rods, bars, shaftings.—Shall be cut in crucible shape, and to be free of casting or other metal attachments. When not in crucible shape, it should be so stated when asking for quotations.

Old Monel metal.—To consist of old Monel metal sheet scrap, free of solder and brazed material and other foreign attachments. If soldered, it should be so stated when asking for quotation.

Monel metal screen and wire.—To be free of soldered material and other foreign material. If soldered, it should be so stated when asking for a quotation.

Monel metal turnings.—To consist of Monel metal from rods or turnings, to be free of nickel alloy turnings, other metals and foreign material, and to be sold subject to sample. Turnings from Monel castings to be packed and sold separately.

Monel metal castings.—To consist of castings made from Monel metal only, and in crucible shape, to be free of other nickel alloy composition material, and when not in crucible shape to be so stated when asking for quotations.

Monel metal punchings.—To consist of clean punchings, free of iron or other foreign material.

German silver (nickel silver), sheet clippings, or skeleton scrap.—To consist of clean sheet cuttings or skeleton material, free of other metals or metal attachments and soldered stock. If lots are of a uniform nickel content, the nickel contents should be so stated and guaranteed, otherwise to be sold subject to sample.

German silver turnings.—Shall consist of clean turnings or chips, free of other metals and foreign material, to be sold subject to sample.

Silver-plated ware.—To consist of spoons, forks, and tableware, free of mesh bags, novelty material and compact cases, also free of nickel-plated material and silver flashed stock.

Mercury (*quicksilver*).—To consist of clean mercury, free of amalgam, zinc dross and tin dross and other foreign material.

Mirror scrapings.—To be sold subject to sample.

Cadmium anodes.—To consist of clean anodes, free of dross, strippings, or other foreign material.

Cadmium strippings.—To be clean stock, free of brass or other foreign material.

Cadmium dross.—To be sold subject to sample.

Bell metal.—Shall consist of large and small bells of a tin-copper composition. It shall be free of yellow brass bells, manganese bells, or other alloy compositions. Cymbals shall be packed separately, and shall not be included in a No. 1 packing of bells.

High-speed tool-steel scrap.—Shall consist of American-made high-speed tool steel with a minimum 15 per cent tungsten contents and shall be free of semi-high-speed tools, high-speed tools with carbon shanks, carbon tools steel or other steel alloyed material.

Molybdenum scrap.—Shall consist of clean, pure molybdenum material in sheet, cast wire or bar stock, and shall be free of nickel or other metal alloys, to be sold subject to sample.

Aluminum foil.—To consist of clean aluminum foil, free of paper, print, pot stack, and other foreign material.

Rifle shells.—Shall consist of clean fired shell, shall be hand-picked and free of any shells containing powder, iron, muffled shells or burnt shells or any material that is foreign. State caliber when asking for quotations.

Cupro-nickel jackets.—To be free of iron, aluminum, or other foreign material, to be sold subject to sample.

NOTE.—When offering alloy material of special character, furnish complete analysis—state what shape it is in, the quantity available, and send a representative sample.

REVIEW OF THE SECONDARY METAL INDUSTRY IN 1929

MARKET CONDITIONS

The total increase in quantity of secondary metals covered in this inquiry was 7 per cent, compared with an increase of 9 per cent in 1928. There were small decreases in the output of tin, nickel, zinc, and antimony, small gains in the output of lead and aluminum, and large gains in the output of secondary copper and copper in alloys other than brass. The much higher average price of copper and the larger output of secondary copper were mainly responsible for the increase in 1929 of $56,417,600 in total value, although the average prices of lead and zinc were also greater in 1929 than in 1928. The price of nickel was stable, and the average price of tin declined appreciably.

With home industries moving at high speed through most of 1929, the domestic demand for scrap copper and scrap brass was good, and often higher prices prevailed than exporters felt warranted in paying. Consequently much smaller quantities were shipped to Europe in 1929 than in 1928. There was also very little holding of material, especially during the latter half of 1929. Scrap copper and copper alloys were promptly shipped to smelters, for there was nothing to be gained, and a possible loss might be incurred, if stocks were held until prices declined. On the whole, returns in the waste-metal industry were the most satisfactory in many years, owing to the higher prices and to the large quantity of material handled.

By no means are all the waste metals resmelted or refined at smelters as metals and alloys of known composition are sold directly to foundries by scrap dealers and by secondary smelters. Large quantities of copper wire, heavy copper, brass, and also aluminum crank cases are purchased directly by small foundries, many of which, unless they are making special castings, use only small amounts, if any, of primary metals. At the same time the large users of alloys continue to increase their purchases of ingot on specifications instead of buying pig metals to alloy at their own plants. The secondary ingot brass sold in 1929 has been estimated at 125,000 tons. By handling large quantities of scrap brass the larger secondary refining plants have been enabled to use material which small smelters and foundries could not utilize owing to impurities. Large melting units make it possible to use low-cost mixtures and yet build up the alloy desired by close attention to analyses. The increasing number of alloys being marketed results in dealers acquiring many greatly varying mixtures of metal waste, and the makers of ingots from this source confidently expect a steady yearly increase in their output.

PRICES OF SOME SCRAP METALS AND ALLOYS

The tables that follow show certain scrap-metal prices at New York in 1929, as quoted by the Waste Trade Journal and the American Metal Market.

The dealers' weekly average buying price in New York of No. 1 heavy scrap copper ranged from 14.63 to 14.88 cents a pound during January. In February the price advanced to 15.75 cents, and early in March it was 16.75 cents; following the advanced price of primary copper the quoted buying price reached 20.25 cents the fourth week in March, the highest quotation in 1929. The price declined the second week in April to 14.25 cents, and in May, June, and July the price ranged from 14.25 cents to 15 cents. There was a decline in the first week in August to 14.63 cents, followed by a quick recovery to 15.25 cents. The opening week in September saw an advance to 15.75 cents, and the price during the remaining weeks in September and October ranged from 15.25 to 15.50 cents. In November there was a decline to as low as 14.75 cents, but the price was held fairly steady at 15 cents until the last week of December, when it advanced to 15.25 cents. The lowest quoted price was 14 cents in April, and the highest was 20.25 cents in March, a spread of 6.25 cents, compared with a spread of 2.35 cents in 1928.

No. 1 composition scrap (red brass) showed a range of 5.12 cents a pound in 1929, compared with a range of 1.85 cents in 1928. It was quoted at 11.5 cents a pound in January, was lowest at 11.13 cents in December and highest at 16.25 cents in March, and closed the year at 11.25 cents.

The price of heavy scrap lead began the year at 5.38 cents a pound; at the end of February it was 5.75 cents; the fourth week in March it reached 6.75 cents, the highest quotation in 1929. The price declined to 5.38 cents in April; in May and June it ranged from 5.38 to 5.50 cents and in July and August from 5.25 to 5.58 cents. In September prices advanced to 5.75 cents, followed by a decline in October. There were slumps in November which carried the quotation as low as 4.75 cents, followed by a sharp recovery to 5.07 cents the last week in November. December opened weak at 4.88 cents, and after a slight advance to 5 cents the price remained at 4.94 cents to the end of the year. The range of the quotations for heavy lead in 1929 was from 4.75 to 6.75 cents a pound.

The range in the price of scrap zinc in 1929 was 0.87 cent a pound compared with 0.50 cent in 1928. The price was 3.75 cents in March and as low as 2.88 cents in December. The opening price in January was 3.5 cents, which was maintained until the fourth week in March.

For that week and the next two weeks the quoted price was 3.75 cents, followed by a decline to 3.5 cents during April. The price fell to 3.38 cents in May and remained steady until the last week in July, when it advanced to 3.5 cents. This quotation held during August. The September price was steady at 3.38 cents. October prices ranged from 3.25 to 3.38 cents, and in November the price declined to 3 cents. The price during the last two weeks of December was 2.88 cents, the lowest in 1929.

There was a much larger range in the quoted prices of cast aluminum in 1929 than in 1928, when the prices ranged from 11.50 cents to 12.25 cents a pound. In 1929 the range was from 9.50 cents to 12.50 cents. The highest prices were in March and April and the lowest in December. New aluminum clippings ranged in price from a high of 17.72 cents a pound in April to a low of 15.62 cents in December. The decrease in price after May was steady and very gradual.

The price of secondary tin, which had a range of 9.39 cents a pound during 1929, usually follows the trend of prices for primary 99 per cent tin. Block-tin pipe was quoted as high as 41.75 cents in January, February, and March. A decline occurred in April, May, and June, followed by advancing prices in July, August, and September. A rapid slump occurred in October and continued until the end of 1929, with the December quotation the lowest of the year.

Of the nonferrous metals tin and copper showed the widest range of prices in 1929. The quotations on antimonial lead battery plates were lowest in November and December. The quantity of battery lead now returned for smelting is estimated by dealers to be about 11,000 tons a month, and the plates are being marketed at prices ranging from 50 to 60 per cent of the prevailing prices for pig lead.

Scrap nickel and nickel alloys were in steady demand, and as the price of nickel remained stable throughout the year the price of scrap fluctuated very little.

Average scrap-metal prices in 1929, in cents per pound[1]

[New York dealers' weekly average buying prices]

Date	No. 1 heavy copper	No. 1 composition	Heavy lead	Scrap zinc	Cast aluminum	Date	No. 1 heavy copper	No. 1 composition	Heavy lead	Scrap zinc	Cast aluminum
Jan. 7	14.63	11.50	5.38	3.50	12.25	July 6	15.00	12.25	5.50	3.38	11.75
12	14.63	11.50	5.38	3.50	12.25	13	15.00	12.25	5.25	3.38	11.75
19	14.63	11.63	5.38	3.50	12.25	20	15.00	12.25	5.25	3.38	11.75
26	14.88	11.88	5.38	3.50	12.25	27	15.00	12.25	5.25	3.50	11.75
Feb. 2	14.88	11.88	5.38	3.50	12.25	Aug. 3	14.63	12.25	5.38	3.50	11.75
9	15.63	12.25	5.50	3.50	12.25	10	15.13	12.13	5.38	3.50	11.75
16	15.75	12.50	5.63	3.50	12.25	17	15.13	12.25	5.58	3.50	11.75
23	15.75	12.75	5.75	3.50	12.25	24	15.25	12.25	5.50	3.50	11.75
Mar. 2	16.75	13.75	6.13	3.50	12.25	31	15.25	12.25	5.50	3.50	11.75
9	16.50	13.75	6.25	3.50	12.25	Sept. 7	15.75	12.75	5.63	3.38	11.25
16	17.75	14.75	6.38	3.50	12.25	14	15.25	12.50	5.75	3.38	11.50
23	20.25	16.25	6.75	3.75	12.50	21	15.50	12.50	5.75	3.38	11.50
30	19.75	15.50	6.50	3.75	12.50	28	15.50	12.50	5.75	3 38	11 50
Apr. 6	18.00	14.50	6.25	3.75	12.50	Oct. 5	15.50	12.50	5.50	3.38	11.50
13	14.25	11.50	5.88	3.50	12.50	12	15.50	12.50	5.50	3.25	11.50
20	14.25	11.75	5.38	3.50	12.38	19	15.50	12.50	5.50	3.25	11.50
27	14.00	11.75	5.38	3.50	12.38	26	15.25	12.50	5.63	3.25	11.25
May 4	14.25	11.75	5.38	3.38	12.38	Nov. 2	15.00	12.13	5.13	3.13	11.25
11	14.50	11.75	5.50	3.38	12.38	9	14.75	11.75	4.88	3.00	10.75
18	14.25	11.25	5.50	3.38	12.25	16	15.00	11.50	4.75	3.00	10.75
25	14.25	11.50	5.50	3.38	12.13	23	15.00	11.50	4.75	3.00	11.00
June 1	14.50	11.50	5.50	3.38	12.13	30	15.00	11.50	5.07	3.00	10.25
8	14.50	11.75	5.50	3.38	12.13	Dec. 7	15.00	11.25	4.88	3.00	9.50
15	14.88	12.00	5.50	3.38	12.13	14	15.00	11.25	5.00	3.00	9.50
22	15.00	12.25	5.50	3.38	12.00	21	15.00	11.13	4.94	2.88	9.50
29	15.00	12.25	5.50	3.38	12.00	28	15.25	11.25	4.94	2.88	9.50

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[1] Waste Trade Journal, New York, Jan. 25, 1930.

The following monthly average prices at New York in 1929 for new scrap-zinc clippings, old zinc, block-tin pipe, and new aluminum clippings, in cents per pound, were quoted by the American Metal Market:

Average scrap-metal prices at New York in 1929, in cents per pound [1]

Month	New scrap-zinc clippings	Old zinc	Block-tin pipe	New aluminum clippings [2]	Month	New scrap-zinc clippings	Old zinc	Block-tin pipe	New aluminum clippings [2]
January	4.62	3.37	41.75	16.87	August	4.37	3.12	38.50	17.62
February	4.62	3.37	41.75	16.87	September	4.37	3.12	38.50	17.62
March	4.64	3.39	41.75	17.37	October	4.35	3.10	35.76	17.58
April	4.87	3.62	39.03	17.72	November	3.93	2.68	32.71	16.95
May	4.53	3.40	37.50	17.62	December	3.68	2.53	32.36	15.62
June	4.37	3.12	37.50	17.62					
July	4.37	3.12	37.95	17.62	Year	4.40	3.16	37.91	17.26

[1] Metal Statistics, 1930.

[2] As corrected by the American Metal Market.

SECONDARY METALS RECOVERED

The quantity of metals contained in numerous alloys made partly or wholly from secondary material can not be ascertained definitely. The figures given as the result of the annual canvass are only approximate, but they constitute the sole available data on an important industry.

The increase in the value of the secondary metals, exclusive of gold, silver, platinum, iron, steel, and ferro-alloys, recovered in the United States in 1929 was due mainly to the higher average price of copper and the greater quantity of copper and copper alloys recovered.

The quantity of secondary platinum metals recovered in the United States in 1929 was 42,759 troy ounces, 13,072 ounces less than in 1928, and equaled 28 per cent of the platinum metals imported for consumption in 1929.

The value of the gold and silver contained in old jewelry, dental waste, tableware, ornaments, and other articles remelted or refined in 1929 was $29,040,000. Mints and refineries reported the recovery of 9,103,300 fine ounces of silver and $24,188,000 in gold from waste or discarded material. Jewelry and dental waste furnished the largest supplies of secondary gold and silverware and photographic waste the largest amount of secondary silver.[5] The consumption of silver in the arts and industries in the United States in 1929 is estimated at 42,359,082 ounces. Most of the silver recovered from photographic waste is obtained from solutions and is recovered by the larger makers of films and plates and by the motion-picture industry.[6] Generally these solutions contain less than half an ounce of silver to the gallon. The recovery from waste film is probably 800 ounces to the million feet.[7]

In 1929 about 13,000 pounds of mercury was obtained in Nevada from old dumps and slimes at mills which formerly treated gold and silver ores by amalgamation. This quantity was about 2,000 pounds less than in 1928. No data are collected by the Bureau of Mines showing the quantity of secondary ferrous metal and alloys collected and sold for remelting or the quantity and value of old rails, pipe, machinery, and other equipment renovated and sold for original use. An immense quantity of such materials is collected and resold. Estimates for old irons and steel collected and reused are as high as 30,000,000 tons, of which about 18,000,000 tons are collected from sources outside of mills and furnaces. The value of the old rails, old pipe, and machinery collected and reused amounts to millions of dollars.

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[5] Hoke, C. M., Methods of Handling Gold and Platinum Wastes: Metal Ind., June, 1927, pp. 240–242, and September, 1927, pp. 371–372.

[6] Weisburg, Louis, Recovery of Silver from Solutions Used in Photographic Work: U. S. Patent 1527942, Feb. 24, 1925.

[7] Byers, C. A., Recovery of Silver from Movies' Laboratory Waste: Eng. and Min. Jour.-Press, Aug. 26, 1922, p. 373.

Secondary metals of certain classes recovered in the United States, 1928 and 1929

	1928		1929	
	Short tons	Value	Short tons	Value
Copper, including that in alloys other than brass	325,000	$93,600,000	417,600	$146,995,200
Brass scrap remelted	302,000	70,935,200	298,500	76,000,000
Lead as metal	138,000	35,797,600	138,500	39,186,000
Lead in alloys	170,600		172,500	
Zinc as metal	70,700	10,150,400	65,400	10,164,000
Zinc in alloys other than brass	12,500		11,600	
Tin as metal	8,200	35,678,300	7,400	30,513,300
Tin in alloys and chemical compounds	27,600		26,900	
Antimony as metal	745	2,451,400	52	1,990,200
Antimony in alloys	11,155		11,079	
Aluminum as metal	24,500	22,848,400	25,850	23,135,200
Aluminum in alloys	23,300		22,550	
Nickel as metal	635	3,150,000	850	3,045,000
Nickel in nonferrous alloys and salts	3,865		3,500	
	----------	274,611,300	----------	331,028,900

Secondary metals of certain classes recovered in the United States, 1920–1929, in short tons

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Copper, including that in alloys other than brass	130,600	113,350	144,100	193,200	196,500	250,600	281,700	290,000	325,000	417,600
Brass scrap remelted	259,800	148,500	274,000	311,000	274,000	242,300	283,000	286,000	302,000	298,500
Lead as metal	56,350	46,370	75,480	96,430	90,400	112,420	125,000	119,000	138,000	138,500
Lead in alloys	68,300	57,410	84,080	98,060	114,100	114,460	152,300	157,000	170,600	172,500
Zinc as metal	42,850	33,833	69,314	65,210	58,886	61,430	64,570	64,800	70,700	65,400
Zinc in alloys other than brass	7,650	5,840	10,250	8,630	10,500	13,300	13,430	12,400	12,500	11,600
Tin as metal	7,200	5,400	6,570	7,892	7,700	7,950	9,750	8,800	8,200	7,400
Tin in alloys and chemical compounds	16,300	11,500	12,940	22,318	23,600	23,000	23,650	28,100	27,600	26,900
Antimony as metal	200	29	182	245	90	1	2,910	1,700	745	52
Antimony in alloys	5,400	4,691	6,908	7,776	9,314	10,839	13,320	10,700	11,155	11,079
Aluminum as metal	5,000	3,650	7,190	6,800	10,350	17,700	20,500	23,000	24,500	25,850
Aluminum in alloys	10,500	5,250	9,100	14,500	16,650	26,300	23,700	23,200	23,300	22,550
Nickel as metal	270	86	104	177	114	191	485	480	635	850
Nickel in nonferrous alloys and salts	1,930	859	1,408	1,373	2,126	2,109	2,565	2,900	3,865	3,500
Total quantity	612,350	436,768	701,626	833,611	814,330	882,600	1,016,880	1,028,080	1,118,800	1,202,281
Total value	$188,507,260	$89,140,500	$143,891,700	$205,418,600	$200,578,600	$243,570,700	$274,540,900	$256,352,000	$274,611,300	$331,028,900

SECONDARY COPPER

Secondary copper recovered in the United States, 1928 and 1929, and imports and exports of brass and copper scrap, in short tons

	1928	1929
Copper as metal	230,000	297,600
Copper in alloys other than brass	95,000	120,000
	325,000	417,600
Copper from new scrap (not including brass)	68,000	113,000
Copper from old scrap (not including brass)	257,000	304,600
	325,000	417,600
Brass scrap remelted:		
New clean scrap	147,000	156,000
Old scrap	155,000	142,500
	302,000	298,500
Copper content of brass scrap (averaging 70 per cent copper):		
New scrap	102,900	109,200
Old scrap	108,500	99,750
	211,400	208,950
Total secondary copper (including copper content of brass scrap):		
From new scrap	170,900	222,200
From old scrap	365,500	404,350
	536,400	626,550
Brass scrap imported	6,077	7,031
Scrap copper imported	5,304	6,797
Brass ("ingots, scrap, and old") exported	42,413	27,746
Scrap copper exported	27,733	18,818

The plants refining mainly primary metal recovered 167,079 short tons of the total secondary copper recovered in 1929, or about 50,756 tons more than they reported in 1928. The copper produced by smelters of secondary material included 130,520 tons of pig copper, 120,000 tons of copper in alloys other than brass, and 208,950 tons of copper in remelted brass. These figures indicate increases of 16,820 tons of pig copper and 25,000 tons in alloys other than brass, and a decrease of 2,450 tons in remelted brass. The total value of the secondary copper as metal and in alloys computed at 17.6 cents a pound—the average price for the year of all marketable grades of new metal—amounted to $220,545,600.

The imports of scrap copper increased from 5,304 short tons in 1928 to 6,797 tons in 1929, and the imports of scrap brass from 6,077 tons in 1928 to 7,031 tons in 1929; most of the imports were from Canada. The exports of scrap copper and scrap brass in 1929 were about two-thirds of those in 1928, as the primary smelters and the makers of secondary ingots were eager buyers of such scrap and competed strenuously with the representatives of European smelters in the eastern coast territory, especially toward the end of 1929. The exports of scrap copper in 1929 were 18,818 tons and those of scrap brass were 26,867 tons.

Railways produce large quantities of both ferrous and nonferrous scrap, most of which is sold to dealers or turned in to smelters as part payment for new metal. Reports in 1929 show that the railways reused at their shops or plants considerably larger quantities of scrap metals, such as babbitt, solder, and bronze, than they did in 1928, although undoubtedly the bulk of their metal wastes was shipped to dealers and smelters. In 1929, the following quantities of scrap metals were utilized by railroads: 5,800 tons of brass; 1,560 tons of copper; 26,500 tons of copper in alloys other than brass; 2,350 tons of tin in babbitt, solder, and bronze; and 5,700 tons of lead in various alloys. Only a very small part of the brass in burned-out electric light bulbs is salvaged, unless prices are high. In the large cities where the quantity easily gathered is of large proportions they are utilized. A description of the method of treating brass lamp shells is given on page 158 of the report on Secondary Metals for 1928.

Some idea of the extent of the recovery of waste metals at foundries, rolling mills, etc., is given in an article by F. A. Westbrook.[8]

Other articles of interest are as follows:

Tomkins, E. S., Secondary Metal Reclaiming: Metal Ind., January, 1929, pp. 14–15.

St. John, H. M., Utilization of Secondary Metals in the Red Brass Foundry: Am. Inst. Min. and Met. Eng. Tech. Paper 242, 1929.

Schenck, W. A., and Scott, J. W., Manufacture of Wire Bars from Secondary Copper: Am. Inst. Min. and Met. Eng. Tech. Paper 246, 1929.

Romanoff, William, and Thieme, C., Application of Brass Ingot Metal in Industry: Metal Ind., July, 1930, pp. 334–335.

Perry, E., White Metals, Brasses, and Bronzes: Metal Ind., August, 1930, pp. 376–377.

The last article, by Perry, contains a table of standard and special bronze mixtures. Copper and tin alloys having 5 per cent or more of tin are usually termed "bronzes," but many containing zinc are a variety of brass, although the zinc content ranges from 2 to 12 per cent.

SECONDARY LEAD

Secondary lead recovered in the United States, 1928 and 1929, in short tons

	1928	1929
Secondary lead recovered by smelters that treat mainly ore	55,930	65,359
Secondary lead recovered by smelters that treat only scrap and drosses	82,070	73,141
	138,000	138,500
Secondary lead recovered in remelted alloys:		
Lead content of antimonial lead scrap treated at regular lead smelters	11,063	15,692
Lead content of drosses and scrap alloys treated at secondary smelters	159,537	156,808
	170,600	172,500
Total secondary lead recovered	308,600	311,000

Refined primary lead produced in the United States, 1928 and 1929, in short tons

	1928	1929
From domestic ore	626,202	672,498
From foreign ore and base bullion	154,869	102,135
Lead content of antimonial lead from foreign and domestic ores and bullion treated at regular smelters	29,626	22,617

The output of secondary lead in 1929 was equal to 40 per cent of the total refined primary lead produced in the United States and was more than 112,500 tons greater than the output of primary lead from ores mined in Missouri, the largest lead-producing State.

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[8] Westbrook, F. A., New Rolling Mill Waste Recovery Plant: Metal Ind., January, 1929, pp. 1–3.

The quantity of secondary lead recovered in 1929 was 2,400 tons more than in 1928; that recovered as pig lead was 500 tons more, of which those smelters whose product is mainly primary metal reported an increase of more than 9,400 tons. The quantity of lead recovered in alloys increased only 1,900 tons. The regular smelters of primary metal reported an increase of about 4,600 tons in the lead content of antimonial lead scrap treated by them, so that secondary smelters in 1929 recovered about 11,700 tons less of pig lead and lead in alloys than they did in 1928.

The main sources of supply of secondary lead are battery plates, lead cable, lead pipe, and lead lining of acid tanks, but large quantities are also derived from babbitt, solder, type metal, terne metal, brass, and white metal drosses. There were considerable stocks of secondary antimonial lead and also of battery plates at the end of 1929. It is quite probable that the dealers' buying price for this scrap will be a smaller ratio of the price of primary lead in 1930 and the demand less keen.

The Engineering and Mining Journal of August 9, 1930 (pp. 123–125), gives an interesting article entitled "Salvaging Lead and Copper in the Telephone Industry."

SECONDARY ZINC

Secondary zinc[1] *recovered in the United States, 1928 and 1929, and products made from zinc dross, skimmings, and ashes, in short tons*

	1928	1929
Secondary zinc recovered by redistillation	48,666	47,348
Secondary zinc recovered by sweating, remelting, etc	22,034	18,052
Total zinc recovered unalloyed	70,700	65,400
Zinc recovered in alloys other than brass	12,500	11,600
Zinc recovered in brass (estimated)	66,000	65,670
Zinc dust made from zinc dross	6,208	7,424
Zinc dross used for zinc dust (estimated)	7,200	8,620
Zinc concentrates and ore exported	4,518	71
Zinc dross exported	3,148	3,490
Lithopone made from zinc skimmings and ashes	61,665	65,364
Secondary zinc content of lithopone	12,186	12,871
Zinc chloride made from zinc skimmings, ashes, etc	44,057	38,357
Zinc content of zinc chloride made from zinc skimmings, etc	9,692	9,116
Zinc content of zinc sulphate made from zinc skimmings, ashes, etc	771	894

[1] Figures do not include scrap and dross used for lithopone, oxide, zinc dust, or chloride. The use for some of these, especially for zinc chloride, is quite large.

Secondary zinc recovered as pig metal and in alloys (including brass) showed a decrease of 6,530 tons in 1929. This decrease was partly in redistilled zinc from drosses but mainly was caused by the large decrease (4,000 tons) in secondary zinc recovered by sweating or remelting.

The quantity of zinc in brass (65,670 tons) and in alloys other than brass (11,600 tons) decreased 1,230 tons. The total recovery of secondary zinc (including that in brass) in 1929 was equal to 23 per cent of the total output of primary zinc in the United States.

The quantity of zinc recovered by redistillation decreased from 48,666 tons in 1928 to 47,348 tons in 1929. Of the 1929 total 19,465 tons, a decrease of 1,777 tons, was recovered at retort smelters that treat mainly ore, and 27,883 tons, an increase of 459 tons, was recovered by redistillation of zinc drosses at six plants that use large graphite retorts of 600 to 800 pounds capacity instead of small clay retorts, such as are used by smelters treating zinc concentrates or mixed concentrates and drosses.

The six zinc smelters that used the large retorts in 1929 were as follows:

Birmingham Smelting & Refining Co., Birmingham, Ala.
Federated Metals Corporation, Trenton, N. J.
General Smelting Co., Philadelphia, Pa.
Superior Zinc Corporation, Philadelphia, Pa.
Tottenville Copper Co., Tottenville, N. Y.
Wheeling Steel Corporation, Wheeling, W. Va.

Of the secondary zinc recovered unalloyed, 72 per cent was obtained by redistillation and the remainder by sweating and remelting. The latter processes do not yield all the metal content, so that the residues are sold to secondary smelters for redistillation or are sold to makers of chemical compounds. Most of the zinc chloride is made from zinc skimmings and other residues; much of the zinc sulphate, zinc dust, and lithopone is also made from such materials, so that there is normally an active market for zinc drosses, skimmings, and ashes. A description of modern practice in producing good zinc from scrap and other wastes, prepared by E. R. Thews, is given in Metal Industry, February, 1927 (pp. 600–602), and March, 1927 (pp. 107–108).

A number of plants, including two in San Francisco, that normally are large exporters, make zinc dust from zinc drosses so that galvanizers on the west coast have a good market for their drosses. However, the demand for zinc skimmings and ashes was very dull; shipments to Europe were small, so that there were some accumulations of stocks at galvanizing plants on the west coast. It is estimated that 8,620 tons of zinc dross was used in 1929 to make 7,424 tons of zinc dust, which was 20 per cent more than in 1928. Of the total output of 206,315 tons of lithopone (a zinc pigment containing approximately 20 per cent of zinc) 65,364 tons containing 12,871 tons of zinc was made from zinc skimmings and ashes, or 3,699 tons more than the quantity of lithopone made from zinc residues in 1928.

The quantity of zinc chloride made in 1929 was 38,381 tons (a decrease of 5,694 tons), of which 38,357 tons, containing 9,116 tons of zinc, was made from zinc skimmings, ashes, galvanized clippings, etc. Zinc sulphate containing 894 tons of zinc was made from skimmings and galvanized clippings.

The exports of zinc dross increased from 3,148 tons in 1928 to 3,490 tons in 1929, which is about one-third of the exports in 1926. The American Bureau of Metal Statistics estimates that 290,000 tons of zinc (1,000 tons less than in 1928) was used in 1929 for zincking (galvanizing) sheets, forms, tubes, wire, etc. Some zinc chloride was made from zincked scrap, but the quantity was negligible, so that the recovery of zinc from this source was very small compared with the consumption of zinc for coating purposes.

Metal Industry reports that zinc from coated clippings can be recovered by placing the clippings in a molten zinc bath or by distilling off the zinc and catching the fume in a cloth bag in a cooling chamber. It is not known whether the practice of using zinc oxide to weight certain cotton products was more extensively used in 1929 than in 1928. It probably was not.

SECONDARY TIN

Secondary tin recovered in the United States, 1928 and 1929

	1928	1929
Tin recovered as pig tin — short tons	8,200	7,400
Tin recovered in alloys and chemical compounds — do	27,600	26,900
	35,800	34,300
Clean tin-plate scrap treated at detinning plants — long tons	204,200	221,643
Old tin-coated containers treated — do	500	----------
Metallic tin recovered at detinning plants — pounds	1,754,549	1,709,264
Tin content of tin tetrachloride, tin bichloride, tin crystals, and tin oxide made at detinning plants — pounds	4,433,751	5,381,243
Total tin recovered at detinning plants — do	6,188,300	7,090,507
Tin tetrachloride, tin bichloride, tin crystals, and tin oxide made at detinning plants — pounds	9,183,943	11,028,529
Average quantity of tin recovered per long ton of old tin-coated containers — pounds	4.0	----------
Average quantity of tin recovered per long ton of clean tin-plate scrap — do	30.3	31.9

Tin (metal) and tin concentrates (tin content) imported into the United States, 1928 and 1929, in short tons

	1928	1929
Tin imported as metal	87,327	97,583
Tin concentrates (tin content) imported	146	143

The United States in 1929 consumed tin in amount equivalent to nearly 50 per cent of the world's output of primary tin in 1929; the domestic production, mainly from Alaska and South Dakota, was only about 55 tons of tin concentrates containing 39 short tons of tin. The secondary tin recovered in the United States in 1929 was equal to 35 per cent of the tin imported into the United States as pig metal in 1929 (97,583 short tons).

The recovery of secondary tin decreased from 35,800 short tons valued at $35,678,300 in 1928 to 34,300 tons valued at $30,513,300 in 1929. The total value assigned is based on the yearly average price (44.48 cents a pound in 1929) given by the American Metal Market for 99 per cent metal, prompt delivery at New York, a price which was 5.35 cents a pound less than the average price in 1928.

The quantity of secondary pig tin recovered decreased 800 tons. The largest recoveries of tin as tin are made from scruff and drosses that occur in making tin plate; these recoveries, according to reports received, decreased from 6,800 tons in 1928 to 6,100 tons in 1929. The quantity of tin plate and terneplate made in 1929 (according to the American Iron and Steel Institute) was 1,968,280 long tons or 129,075 long tons more than in 1928. The quantity of tin estimated to have been used for such products is 28,622 long tons. The quantity of tin recovered in alloys and chemical compounds decreased 700 tons, owing to the lower recovery in alloys.

Nearly all detinning in the United States is done by the electrolytic process or by the chlorine process. Many of the earlier chapters of this series contain data relating to the plants and processes followed, and a complete history of the different methods of detinning is given in an article entitled "Scrap Detinning Affords Big Outlet for Chlorine," by C. L. Mantell, in Chemical and Metallurgical Engineering, August, 1926 (pp. 477–479).

Tin-plate clippings imported in 1928 amounted to 10,291 tons, which came from Canada.

Reports received show that the clean tin-plate scrap detinned in 1929 was 17,443 long tons more than in 1928 and that a greater quantity of tin compounds and less metallic tin were made than in 1928. The average tin content of the tin oxide made by detinners was given as 78 per cent, that of the tin bichloride as 24.5 per cent, and that of tin tetrachloride as 45.4 per cent. The average cost of tin-plate clippings detinned at the plants in 1929 was $11.51 a long ton, and the average recovery of tin per long ton of clean tin-plate scrap was 31.9 pounds.

Tin-plate makers have reduced the amount of tin consumed per ton of tin plate made and at the same time have improved the quality by a more uniform distribution of the tin and by improved trimming methods. These improvements have materially decreased the quantity of tin that detinning plants can salvage from about 39 pounds to about 31 to 32 pounds per long ton.

New tin-plate clippings were treated at plants of the Vulcan Detinning Co. at Sewaren, N. J., Neville Island, Pa., and Streator, Ill.; by the Johnson & Jennings Co., of Cleveland, Ohio; and at the plants of the Metal & Thermit Co. at South San Francisco, Calif., East Chicago, Ind., and Chrome, N. J.

Several plants are equipped to handle 40,000 tons of old tin-coated containers, but they have never operated at full capacity. In recent years only small quantities of old cans have been treated, even when the price of tin was much higher than it was in 1929. The cost of collecting the old cans is too great to permit profitable operation. No old tin-coated containers were treated for the recovery of tin coating in 1929. In Philadelphia, Los Angeles, and other cities some old cans are melted for sash weights. Only local material is used, and no attempt is made to recover the tin. A new plant in Los Angeles also treats old cans by cleaning, shredding, and baling for use in precipitating copper from mine waters. This detinned steel scrap is much more efficient for this purpose than miscellaneous iron and steel scrap, and thousands of tons are now used. With the extension of copper precipitation the use of baled scrap will increase. At the new plant of the Utah Copper Co. detinned scrap only is used. This plant at Copperton, Utah, is 976 by 49 feet, with four launders, and it is stated that recoveries now average 95 per cent of the copper in waters run through the launders.[9]

The tin reported recovered in alloys and compounds in 1929 included the tin content of products made from clean tin-plate scrap. Most of the tin recovered at the plants listed was in tin bichloride, tin tetrachloride, and tin oxide. As the products are made from scrap tin and thus conserve the primary metal they are properly regarded as recovered tin.

It is estimated that about 32,050 short tons of tin was used in the United States in 1929 by the makers of tin plate and terneplate, and that the total recovery of secondary tin as metal and in compounds from tin-plate scrap in 1929 was 3,545 tons. Most of this was recovered in tin compounds and not as metal, for there was a greatly increased consumption of tin compounds by the silk industry.

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[9] Martin, Gail, A Modern Scrap-Iron Precipitation Plant: Eng. and Min. Jour., Sept. 21, 1929, pp. 467–469.

The following articles on the recovery of tin and alloys containing tin are of interest:

The Production of White Bearing Metals and Tin Solders from Scrap Metals: Metal Ind., September, 1928, pp. 394–396.

Buttfield, Gibson, Advances in Reclaiming Tin from Silk Weighting Washings: Chem. and Met. Eng., October, 1928, p. 607.

Technical Paper 236 of the American Institute of Mining Engineers, by P. J. Potter, gives data relating to the recovery of wastes from tin base babbitting operations. A book written by C. L. Mantell of Pratt Institute, Brooklyn, N. Y., entitled "Tin, Its Mining, Production, Technology, and Application," includes chapters on the sources of secondary tin and on the various methods of detinning tin-plate scrap.

SECONDARY ANTIMONY

Secondary antimony recovered in, primary antimonial lead produced in, and antimony imported into and exported from the United States, 1928 and 1929, in short tons

	1928	1929
Secondary antimony in antimonial lead scrap smelted at regular smelters	1,355	1,883
Secondary antimony recovered at secondary smelters	10,545	9,248
	11,900	11,131
Primary antimonial lead produced at regular smelters	33,058	25,669
Antimony content of primary antimonial lead	3,432	3,052
Antimony imported in ore, as metal, or as oxide or salts	15,720	16,963
Foreign antimony exported	599	509

The production of secondary antimony in the United States in 1929, nearly all of which was recovered in alloys, aggregated 11,131 short tons, a decrease of 6 per cent from the recovery reported in 1928. The average price of ordinary brands of antimony in 1929, as published by the American Metal Market, was 8.94 cents a pound, compared with 10.3 cents in 1928. Those smelters that ordinarily use primary ores, concentrates, or metals reported the recovery of 1,883 tons of antimony contained in 15,692 tons of antimonial lead scrap, or 528 tons more than they reported in 1928. The recovery of secondary antimony by the secondary smelters, on the contrary, showed a decrease of 1,297 tons from that in 1928.

The imports of antimony in 1929 increased about 1,250 short tons, and the quantity of primary antimonial lead made at regular smelters decreased nearly 7,400 tons.

There was an increased number of batteries made for the automobile industry in 1929 and probably a decreased number of batteries for other purposes. Some secondary smelters estimate that the quantity of old battery plates and mud has increased from 12,000 tons a month to between 13,000 and 14,000 tons a month. At plants there were fair stocks of old batteries which were not smelted in 1929.

The principal materials refined or remelted that contained antimony as an alloy were hard-lead drosses, babbitt, bearing metal, battery plates, pewter, and type metal. The antimony used in the pigment, paint, and ceramic industries is so dissipated that no secondary recoveries can be made, but a large proportion of the production of metal containing antimony returns in a few months or a few years for refining and reuse. Dealers and brokers return much of the battery plates, and users of bearing metal and type metal regularly ship their used material to the makers of type metal and bearing metal and are credited with its value against the shipments of refined alloys.

Most of the old battery plates are collected by dealers and shipped to secondary smelters that buy them at a price based on the price of pig lead at St. Louis. The antimony content is paid for at the price of lead; this price in 1929 was 6.3 cents, or about 2.64 cents less than the average price of ordinary brands of antimony. As antimony is used mainly in an alloy it is seldom separated in refining scrap.

SECONDARY ALUMINUM

Secondary aluminum recovered in the United States, 1928 and 1929, in short tons

	1928	1929
Secondary aluminum recovered unalloyed	24,500	25,850
Aluminum recovered in alloys (mainly No. 12)	23,300	22,550
	47,800	48,400

Primary aluminum produced in the United States and imported and exported, 1928 and 1929

	1928	1929
Primary aluminum produced in the United States ..... pounds	210,000,000	225,000,000
Aluminum (crude and semicrude) imported for consumption ..... do	38,847,007	50,880,823
Aluminum (crude and semicrude) exported ..... do	15,728,281	17,032,117

The value of primary aluminum produced in the United States in 1929 was $51,864,000, compared with $47,899,000 in 1928.

The recovery of secondary aluminum as pig aluminum or in alloys amounted to 48,400 tons in 1929, valued at $23,135,200, compared with 47,800 tons in 1928, valued at $22,848,400.

Some of the larger secondary smelters, refiners, and users of aluminum in 1929 were as follows:

Aluminum Industries (Inc.), Cincinnati, Ohio.
Aluminum Smelting & Refining Co., Cleveland, Ohio.
Apex Smelting Co., Chicago, Ill.
Aurora Refining Co., Aurora, Ill.
Bohn Aluminum & Brass Corporation, Detroit, Mich.
Cleveland Electro Metals Co., Cleveland, Ohio.
Fairmont Aluminum Co., Fairmont, W. Va.
Federated Metals Corporation, New York, N. Y.
General Metals Refining Co., St. Louis, Mo.
Hamden Smelting Co., Hamden, Conn.
Wm. F. Jobbins (Inc.), Aurora, Ill.
The Maytag Co., Newton, Iowa.
Michigan Smelting & Refining Co., Detroit, Mich.
National Bronze & Aluminum Foundry Co., Cleveland, Ohio.
National Smelting Co., Cleveland, Ohio.
National Smelting & Refining Co., Detroit, Mich.
Niagara Falls Smelting & Refining Corporation, Buffalo, N. Y.
M. L. Oberdorfer Brass Co., Syracuse, N. Y.

Peninsular Smelting & Refining Co., Detroit, Mich.
South Bend Smelting & Refining Co., South Bend, Ind.
Standard Aluminum Castings Co., Lansing, Mich.
United States Aluminum Co., Cleveland, Ohio.
United States Reduction Co., East Chicago, Ind.

A large quantity of No. 12 secondary ingots (92 per cent aluminum and about 8 per cent copper) is made by smelters from old or defective castings, borings, and scrap, but the number of alloys containing aluminum has greatly increased in recent years, and the use of No. 12 alloy is very much less than it was.

Ernest V. Pannell, of the British Aluminum Co. (Ltd.), recently compiled a list of 65 casting alloys of aluminum, each of which had its distinctive properties and merits. He also states that there are probably 25 different compositions of forging alloys in use containing aluminum.

The scrap and waste aluminum available to foundry users and secondary smelters includes chiefly drosses and skimmings, bearings, grindings and similar machining scrap, heavy cast scrap (principally automotive castings), fabricating scrap, and old sheet and utensils. Good clean aluminum scrap is comparatively scarce, and the quantity of dross from the melting of aluminum is small compared with the quantity of drosses and skimmings from aluminum alloys. Considerable waste aluminum came from the plants making electrolytic zinc.

In his article on The Contamination of Aluminum Scrap (see reference p. 200), Anderson, who estimates the quantity of secondary aluminum treated at about 50,000 tons annually, discusses the changes in the character of much of the aluminum scrap now returned for remelting. He expects that the difficulties in sorting, handling, and smelting will increase as more alloys containing aluminum are introduced and that the smelter will be forced to adopt more rigid control, chemical and metallurgical, in his operations. He also says that there are many causes for the contamination of metal scrap, the chief ones being as follows:

Admixture of various alloys.
Methods of production in manufacturing plants.
Design and construction of parts (containing different metals).
Carelessness in handling either at plants of origin or in dealers' yards.
Ignorance or lack of experience with new products and their composition.
Inferior grades of primary or secondary metal.

The following is the text of specifications for the purchase of aluminum scrap adopted by the members of the Aluminum Research Institute in March, 1930:

> The Aluminum Research Institute was organized several months ago by the major secondary aluminum smelters. The object of the organization is to improve and develop the business of manufacturing aluminum alloys and to endeavor to solve the problems which arise in connection with raw materials and with the making and distributing of aluminum alloys. The Institute is working out methods of standardizing the analysis of aluminum wastes and scrap because the assays by commercial laboratories and by smelters frequently do not check within reasonable limits.
>
> *Scrap aluminum castings.*—Shall consist of clean, heavy automobile castings, containing not more than 12 per cent industrial mixed castings both of which must be free from die cast aluminum, pistons, pattern metal and hat blocks. All of the above material also to be free from iron, babbitt, brass, and any other foreign substance. Oil and grease must not exceed 2 per cent.
>
> *Scrap sheet aluminum.*—Shall consist of clean, old, unalloyed sheet aluminum, guaranteed free from iron, dirt, and all foreign metals and substances.

Painted scrap sheet aluminum.—Shall consist of clean, old, painted, unalloyed sheet aluminum, guaranteed free from iron, dirt, and all foreign metals and substances.

New aluminum (pure) clippings.—Shall consist of new, clean, dry, unalloyed aluminum clippings and cuttings, free from punchings and all other foreign materials.

New aluminum alloy clippings.—To be handled on specification or sample.

Aluminum pistons.—Shall consist of clean aluminum pistons, free from iron and any other foreign substance.

New aluminum wire and cable.—Shall consist of new, clean, dry, unalloyed aluminum wire or cable, free from iron, insulation, and any other foreign substance.

Old aluminum wire and cable.—Shall consist of old, unalloyed aluminum wire or cable, containing not over 1 per cent free oxide or dirt, and free from iron, insulation, and any other foreign substance.

Aluminum borings.—To be handled on specification or sample.

Aluminum drosses.—To be handled on specification or sample.

Aluminum grindings, sawings, and sweepings.—To be handled on specification or sample.

Aluminum spatters.—To be handled on specification or sample.

Aluminum spinnings.—To be handled on specification or sample.

Aluminum foil.—To be handled on specification or sample.

The sources of aluminum and aluminum scrap alloys are as follows:

Clippings and sheets from utensils and automobile body works.

Foil, clean or coated.

Cable, clean or dirty.

Castings, pure or unalloyed, classified as (1) clean castings never in use, (2) dirty, reclaimed from machinery, and (3) dirty scrap cleaned.

Borings, turnings, etc. (machine shops convert 10 to 12 per cent of rough castings into fine particles; their value depends on cleanliness).

Skimmings from melting (they vary widely in metal content).

Grindings and buffings.

Sludge—residue from refining operations, usually worthless.

Dross—aluminous oxide and metal from fluxing operations.

Under normal conditions remelt ingot will sell at about 4 cents a pound below 99 per cent virgin ingot, clippings at 7.5 cents below virgin ingot, clean scrap castings 10 cents below virgin ingot, and borings 15 cents below virgin ingot.

A series of articles relating to aluminum is as follows:

Anderson, Robert J., Hughes, George E., and Anderson, Marshall B., Melting Aluminum in Large Quantities: Metal Ind., April, 1929, pp. 164–166.

Anderson, Robert J., The Contamination of Aluminum Scrap: Am. Metal Market, April 25, April 26, April 29, April 30, 1930.

Anderson, Robert J., Smelting Secondary Aluminum and Aluminum Alloys: Metal Ind., October, 1929, pp. 469–471.

Fullis, D. R., Developments in the Refinement of Secondary Aluminum: British Metal Ind., April 5, 1929, pp. 339–340; April 12, 1929, pp. 371–372.

SECONDARY NICKEL

Secondary nickel recovered in the United States, 1928 and 1929, in short tons

	1928	1929
Nickel recovered as metal	635	850
Nickel recovered in nonferrous alloys and salts	3,865	3,500
	4,500	4,350

Primary nickel produced in the United States and imported and exported, 1928 and 1929, in short tons

	1928	1929
Nickel produced as a by-product from the electrolytic refining of copper at domestic refineries	522	340
Nickel imported for consumption in the United States as nickel or in nickel ores and matte, oxide, and alloys	34, 664	48, 405
Nickel, Monel metal, and other alloys exported	1, 175	1, 435

The nickel reported as recovered from secondary sources includes nickel in Monel metal (a natural alloy) but not that in ferrous alloys. The military uses of nickel are less than half their former quantity. According to R. C. Stanley, president of the International Nickel Co., about 40,000 tons of nickel was utilized in 1929, and of this about 18,400 tons was used in structural nickel, steel nickel, steel castings, corrosion-resistant rails, ferro-nickel alloys, nickel cast iron, and heat-resisting alloys. The other uses of nickel consumed 21,600 tons; the secondary nickel recovered, 4,350 tons, came from these sources, which include scrap nickel anodes, nickel silver, copper nickel alloys, Monel metal, nickel bronze, etc. The greatest consumption of nickel in nonferrous alloys is for nickel silver, nickel plating, and malleable nickel.

The secondary nickel recovered from nonferrous sources in the United States in 1929 was equal to 9 per cent of the nickel imported; it was recovered mainly as Monel metal, old anodes, and nickel silver.

The nickel produced as a by-product from the electrolytic refining of copper in 1929 was 182 tons less than in 1928, but the nickel imported for consumption as nickel ores, matte, oxide, and alloys in 1929 exceeded that of 1928 by 13,741 tons. As the use of nickel and its alloys for kitchen and serving equipment, bath fixtures, refrigeration, heat treatment of metals, and chemical utensils is rapidly expanding, the secondary recovery will continue to grow.

The beneficial use of nickel in some brasses and bronzes has been set forth by metallurgists, and its use for such purposes continued to expand in 1929.

Analyses of various nickel alloys were published in Mineral Resources, 1915.[10]

Considerable information as to the uses of nickel, Monel metal, and other nickel alloys is given in Inco, the publication of the International Nickel Co. This company purchases nickel scrap and Monel scrap. A flat offer is made for metal containing not less than 64 per cent of nickel, not less than 27 per cent of copper, not more than 3½ per cent of iron, and not more than 0.05 per cent of sulphur. The scrap must be free from lead and zinc. If the scrap offered is not up to above specification, settlement will be made on a basis of nickel and copper content. As the cost of sampling and analyzing is high, it is necessary to avoid small shipments of scrap, and not less than 500 pounds should be offered for sale.

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[10] Hess, F. L., Nickel: Mineral Resources of the United States, 1915, Pt. I, pp. 763-765.

CHROMITE[1]

By Lewis A. Smith[2]

INTRODUCTION

The United States produces a negligible quantity of chromite and imports over half of the world's output. In 1929, 318,000 long tons were imported, an increase of 101,000 tons over 1928. This increase is approximately equal to two-thirds of the estimated increase in world production and was largely attributable to augmented consumption of chromite in the manufacture of ferrochromium and refractories.

The outstanding development along metallurgical lines in 1929 was the increased use of Nirosta metal (18 per cent of chromium and 8 per cent of nickel in iron). The Ford Motor Co. is now using this metal for the bright parts on Ford automobiles. It is also being used for ornamental and noncorrosive fixtures in the Chrysler and Empire State buildings in New York City.

The chromium-plating industry increased its production in 1929, and the tanning and pigments industries are believed to have held their own.

The development of the large low-grade chromiferous area in the vicinity of Collins and Armstrong stations, Ontario, Canada, is the most important feature of the Canadian chromite situation. Experiments conducted by the Consolidated Mining & Smelting Co. on a British Columbian deposit may result in a noteworthy enterprise.

Cuban deposits near Camaguey continued to ship increasing quantities of chromite to the United States where the ore was probably utilized in the manufacture of refractories. The Caledonia mine, which produced considerable ore in the past, was exhausted. New deposits have been disclosed which may lead to a maintenance of reserves for 1930. No production of Mayari nodulized ore was reported during the year, but shipments were made from stocks.

Guatemalan deposits are being reopened. No chromite was produced in Brazil, but a small amount was shipped to the United States from stocks.

In Europe, Greece and Yugoslavia increased their outputs of chromite, and Russia probably maintained its production. All three countries are said to have increased exports, most of the Greek output being sent to the United States. Germany, Sweden, Great Britain, and Norway were the largest importers of chromite. Norway and Sweden have ample cheap hydroelectric power which permits the use of electric-furnace methods for the manufacture of ferrochromium and stainless steels. In Sweden the Forsbacka Iron Works has finished a new plant which employs the Flodin-Gustavson electric-smelting process. This plant was built for the manufacture of stainless iron by direct smelting of iron ore and chromite, thus eliminating the introduction of chromium through the medium of ferrochromium. In view of the relatively low percentage (55 to 65 per cent) of extraction of chromium in the chromite used in manufacturing ferrochromium, this process, if successful, should be important. Germany manufactures considerable alloy steel and bichromates for export and home consumption, and the United Kingdom uses chromite in the manufacture of ferro-alloys, refractories, and chemicals. Germany, United Kingdom, Sweden, and Norway imported or consumed about 110,000 tons of chromite in 1928, and indications are that their consumption of chromite increased in 1929.

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[1] Work on manuscript completed November, 1930.

[2] Unless otherwise stated, statistics in this report were prepared by H. M. Meyer and data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

Prospecting and development work were carried out actively during 1929 in Turkey and resulted in the discovery of new chromite deposits and increased reserves. Considerable competition for control of the Turkish deposits has developed between French, German, British, Swedish, Italian, and American capital. The final result of the various quests has not been announced, but several companies have succeeded in acquiring properties in the Makri, Brusa, and Adalia districts. It is rumored that several other properties have been offered as concessions to foreign capital.

The Indian mines produced around 50,000 long tons, and promising new developments are reported in the Singhbhum district. No new concessions were granted in Baluchistan, one of the important Indian sources of chromite, but production increased.

Presumably, the Wakamatsu deposits in Japan continued to produce enough chromite to meet domestic needs. A small output, the first since 1924, is reported from Indo-China. Nothing further has been heard concerning the chromite deposits of Ceylon.

In Africa, Southern Rhodesia continued to lead the world in production with about 262,000 long tons. Important new developments were made along the Great Dyke in the Hartley, Lomagundi, Victoria-Mashaba, and Umvukwes sectors. The new railway system connecting the Lomagundi field with Salisbury has progressed satisfactorily and will open up a great new region hitherto only slightly productive. The Great Dyke is now fairly well prospected from Victoria on the south to the Umvukwes on the north, and developed reserves include millions of tons of ore.

The Transvaal deposits at Lydenburg and Rustenburg have been developed further, and reserves are estimated at several millions of tons. Production was materially increased in 1929, and some of the prejudice against South African chromite caused by its high iron oxide content is said to have been overcome.

New discoveries are reported in Sierra Leone and Tanganyika, but little information as to their importance is as yet available.

New Caledonia increased its exports in 1929, and reserves were reported at about 1,500,000 tons of 50 per cent ore. Owing to the greater depths of mining, costs are said to have increased. Moreover, taxes and transportation costs are high in New Caledonia as compared with other producing centers.

In general, reserves in these countries are sufficient to meet world demands for many years at a relatively low price. The great reserves of Rhodesia, Union of South Africa, New Caledonia, and

Turkey alone are capable of supplying present world demands. Rhodesian and South African reserves have been estimated at many millions of tons and estimates of Turkish deposits indicate several million additional tons. New Caledonia is said to have 1,500,000 tons blocked out, and Russia has potential reserves. Supplies of ore in Greece, Yugoslavia, Japan, Cuba, Australia, Rumania, Canada, Indo-China, Austria, and the United States vary greatly. With the increasing utilization of chromite in metallurgical and other lines, these various reserves will certainly be called on before long to supply increasing amounts of ore.

CHROMITE MINING IN THE UNITED STATES

In the United States, 543 long tons of chromite were mined during 1929, and 269 tons were shipped, as compared with 368 tons mined and 660 tons shipped in 1928. The entire shipments were made from properties located in Mendocino, San Luis Obispo, Tehama, and Trinity Counties, Calif.

The Red Mountain mine, near Cummings, Mendocino County, shipped a car of 50 per cent ore to San Francisco, and the operator states that he will continue shipments in 1930. The Sweetwater mine, in San Luis Obispo County, was operated for a short time, and P. A. H. Arata shipped ore from the Pick and Shovel mine near San Luis Obispo. A small quantity of chromite was produced in Shasta County but was not shipped. Savage Bros., near Red Bluff, Tehama County, installed concentrating machinery at their property. A test run was made on the ore, which consists of disseminated chromite grains in dunite; 54 long tons of concentrates, averaging 50 per cent Cr_2O_3, was obtained. This product was bought by a steel company and is said to have proved highly satisfactory. Heretofore, transportation by truck over 5 miles of poor road to Red Bluff cost \$5.50 a short ton, but with the road rebuilt the cost may be lowered to about \$3 a ton. The ore was difficult to treat because of the presence of considerable magnesite which slimed very readily and subsequently carried away a large part of the fine chromite. An attempt is to be made to recover this chromite by using magnetic separators. A. W. Thompson mined about 200 long tons of 40 to 58 per cent chromite at his property in Trinity County, but did not ship it. Chromite was produced and shipped from the Crows Crest mine, Gibson, Trinity County.

As a result of the development work campaign carried out by the Chromium Corporation at the Benbow property in Stillwater County, Mont., 2,475 tons of chromiferous material, averaging 19 per cent of Cr_2O_3, was produced, 285 tons of which, averaging 21 per cent of Cr_2O_3, was sorted out and shipped to the Ardsley Butte mill for a concentration test. About 75 tons of concentrates averaging 41 per cent of Cr_2O_3 was obtained and shipped east for further tests. It has been suggested that the iron oxide content of the chromite in this area is relatively high, and concentration is said to have increased the iron to above the market limits set by refractory and ferrochromium manufacturers. The property was shut down in December, 1929.

Harry Sordy continued development work on his Oregon Chrome mine at Galice, Josephine County, Oreg. Considerable ore has been stocked on the dump awaiting more favorable market conditions.

The deposit of chromite, located about one and a half miles from the Southern Railway at Louise, Troup County, Ga., attracted some attention. The owners believe that further prospecting will disclose a workable tonnage of chromite. A test lot of the ore was shipped to the Rustless Iron Corporation of America, at Baltimore, Md., but proved to be unsatisfactory for the company's needs.

The following table shows the shipments of chromite in the United States, 1924 to 1929, inclusive, in long tons.

Crude chromite mined and shipped from mines in the United States, 1924–1929, by States

State	Ore containing 45 per cent or more of chromic oxide			Ore containing 35 to 45 per cent of chromic oxide			Total value
	Mined (long tons)	Shipped (long tons)	Value	Mined (long tons)	Shipped (long tons)	Value	
1924							
California	213	188	$940				$940
Montana				20			
Oregon					[1] 100	[1] $200	[1] 200
	213	188	940	20	[1] 100	[1] 200	[1] 1, 140
1925							
California	83	83	1, 650				1, 650
Maryland	25	25	455				455
Oregon				47			
Washington	2						
	110	108	2, 105	47			2, 105
1926							
California	127	47	957		44	22	979
Maryland	67	50	1, 100				1, 100
	194	97	2, 057		44	22	2, 079
1927							
California	50	[2] 201	[2] 5, 063				[2] 5, 063
1928							
California	152	206	3, 392	179	446	11, 250	14, 642
Maryland	12	8	165				165
Montana				25			
	164	214	3, 557	204	446	11, 250	14, 807
1929							
California	383	182	2, 712	160	87	1, 264	3, 976
	383	182	2, 712	160	87	1, 264	3, 976

[1] Ore from Oregon in 1924 contained less than 35 per cent of Cr_2O_3.

[2] According to the quarterly report of the Division of Mines and Mining, Department of Natural Resources, California, April, 1928, p. 161, which states that 225 short tons (201 long tons) of chromite were sold in 1927. No shipments for 1927 were reported by the producers to the Bureau of Mines.

IMPORTS

The United States imported 317,630 long tons of chromite during 1929, an increase of 101,038 long tons, or 47 per cent, over 1928. This increase was due largely to the increased manufacture of ferrochromium for alloys and, to a less extent, to a probable increase in the manufacture of chromite refractories indicated by increased imports of ore of refractory grade from Cuba, South Africa, and Greece.

The following table shows the percentage of total imports of chromite coming from the six most important producing countries during 1928 and 1929.

Country	1928	1929	Country	1928	1929
	Per cent	*Per cent*		*Per cent*	*Per cent*
Southern Rhodesia	51.74	52.70	British India	8.12	6.62
Cuba	15.56	16.67	Union of South Africa	7.27	5.52
New Caledonia	7.00	8.45			
Greece	7.92	8.39	Total	97.61	98.35

The following table shows the imports of crude chromite into the United States by countries, 1924 to 1929.

Crude chromite imported into the United States, 1924–1929, in long tons

[General imports]

Country	1924	1925	1926	1927	1928	1929	
						Quantity	Value
Africa:							
British—							
East		678	1,000				
South [1]	21,642	18,463	17,794	6,935	15,745	17,545	$128,599
Portuguese—							
East [2]	37,152	70,718	105,022	128,851	112,073	167,381	1,087,822
Other	26,287	6,805	7,724	21,263	4,000		
Belgium						1,367	34,583
Brazil			1,840	729	320	462	9,898
Cuba	8,145	29,830	36,020	16,983	33,707	52,949	504,082
Germany						1,700	13,971
Greece	13,390	12,533	21,065	22,527	17,152	26,647	320,805
Guatemala			53				
India (British)	7,335	8,360	13,800	13,572	17,591	21,033	278,870
Japan		300					
Malta, Gozo, and Cyprus					600		
Netherlands					50		
Oceania (French)	4,392	2,032	11,146	11,500	15,154	26,846	270,039
Turkey in Asia					200	1,700	17,819
United Kingdom		20					
	118,343	149,739	215,464	222,360	216,592	317,630	2,666,488

[1] Recorded as Union of South Africa for 1927, 1928, and 1929.

[2] Recorded as Mozambique for 1927, 1928, and 1929.

The following table shows the nationality of bottoms carrying chromite into the United States in 1927, 1928, and 1929.

Chromite shipped into the United States and nationality of bottoms in which shipped, 1927–1929, in per cent of total

Nationality	1927	1928	1929	Nationality	1927	1928	1929
United States	21.7	24.0	27.2	Japanese	0.4		
British	70.4	70.3	61.5	Norwegian	3.3	3.6	7.8
Danish			2.2	Swedish	.9		.4
French	3.3	2.1					
Italian			.9		100.0	100.0	100.0

The following table shows the quantity of chromite carried to the United States from each exporting country and the nationality of the ships engaged in the traffic during 1927, 1928, and 1929.

Chromite shipped into the United States and nationality of bottoms in which shipped, 1927–1929, in long tons [1]

Country	Flag	1927	1928	1929
Belgium	United States Shipping Board			1,414
Brazil	British		800	
	Swedish	1,825		1,100
		1,825	800	1,100
Cuba	United States (Independent)	6,891	94	9,926
	British	3,627	25,630	14,083
	Danish			7,093
	Norwegian	6,462	6,457	21,758
		16,980	32,181	52,860
France	do			3,184
Greece	United States (Independent)			5,016
	British	2,470	2,690	8,402
	Italian			2,749
	Japanese	800		
		3,270	2,690	16,167
India	United States Shipping Board	1,010	2,750	15,140
	United States (Independent)			1,500
	British	7,100	7,100	2,000
		8,110	9,850	18,640
Mozambique	United States (Independent)	29,361	40,279	53,598
	British	123,185	90,294	146,755
		152,546	130,573	200,353
Netherlands	United States Shipping Board		50	27
New Caledonia	United States (Independent)	4,818		
	British			23,505
	French	6,410	3,777	
		11,228	3,777	23,505
Sweden	Swedish			25
Turkey	British			850
	French			50
				900
Summary	United States Shipping Board	1,010	2,800	16,581
	United States (Independent)	41,070	40,373	70,040
	British	136,382	126,514	195,595
	Danish			7,093
	French	6,410	3,777	50
	Italian			2,749
	Japanese	800		
	Norwegian	6,462	6,457	24,942
	Swedish	1,825		1,125
		193,959	179,921	318,175

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[1] Division of statistics, Bureau of Research, U. S. Shipping Board, C. D. S. No. 1239, May 9, 1929; subject to revision.

The following tables show the imports of chromium alloys and compounds into the United States during the past few years.

Ferrochrome or ferrochromium, chrome or chromium metal, and chromium vanadium imported for consumption in the United States, 1925–1929, in long tons

	1925	1926	1927	1928	1929
Ferrochrome or ferrochromium:					
Containing 3 per cent or more of carbon (chromium content)	69	15	1	69	37
Containing less than 3 per cent of carbon, gross weight	588	495	143	611	638
Chrome or chromium metal	3	1	10	10	21
Chromium vanadium	32	20			

Chromium compounds imported for consumption in the United States, 1920–1929

Year	Chromic acid		Chromate and bichromate of potash		Chromate and bichromate of soda		Chromium chloride and sulphate	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1920	1,100	$90	4,414	$2,690	----------	----------	(1)	(1)
1921	1,969	674	73,011	6,772	64,236	$5,308	(1)	(1)
1922	4,663	1,289	8,584	1,676	22,731	1,540	(1)	(1)
1923	4,632	2,026	5,563	1,033	245	73	2,771	$654
1924	32,493	2,484	10,486	1,924	----------	----------	9,095	1,340
1925	5,564	2,216	4,379	778	221	46	3,520	941
1926	7,220	2,892	8,177	1,449	220	44	1,310	693
1927	15,620	9,755	5,007	906	330	67	40,650	2,419
1928	99,617	24,547	6,866	1,112	1,752	287	110	33
1929	462,486	84,683	8,880	1,537	350	80	3,823	509

[1] Not separately classified prior to change in tariff, Sept. 22, 1922. None recorded Sept. 22 to Dec. 31, 1922.

The increased consumption of chromic acid in the electroplating industry was reflected by the increase of imports from 99,617 pounds in 1928 to 462,486 pounds in 1929. In 1929 the acid was valued at $84,683 as compared with $24,547 in 1928, average values per pound of 19 cents in 1929 and 25 cents in 1928.

Imports of potassium chromate or bichromate increased somewhat and the average value per pound increased from 16 cents in 1928 to 18 cents in 1929. Imports of sodium chromate and bichromate were negligible. Imports of chromium sulphate and chromium chloride increased from 110 pounds to 3,823 pounds.

CONSUMPTION

Owing to lack of data concerning consumers' stocks it is not possible to give figures covering the consumption of chromite in the United States. The following table, however, gives the apparent available supply (imports plus domestic production) from 1920 to 1929, by years.

Domestic sales, imports, and supply of chromite in the United States, 1920–1929, in long tons

Year	Sales from domestic mines	Imports (general)	Apparent available supply	Year	Sales from domestic mines	Imports (general)	Apparent available supply
1920	2,502	150,275	152,777	1925	108	149,739	149,847
1921	282	81,836	82,118	1926	141	215,464	215,605
1922	355	90,081	90,436	1927	[1]201	222,360	222,561
1923	227	128,763	128,990	1928	660	216,592	217,252
1924	288	118,343	118,631	1929	269	317,630	317,899

[1] According to the division of mines and mining, department of natural resources, California.

According to this table the apparent available supply of chromite increased 46 per cent. However, while the amount of consumers' stocks is not definitely known, it is believed that it is fairly large to insure constant supply in event of price fluctuations or interruptions in trade. During 1929, there was a marked increase in the use of ferrochromium in alloys, a relatively less important increase in refractories, and a slight increase in chemicals.

USES

METALLURGICAL

A marked increase in the amount of ferrochromium manufactured in 1929 indicates an increased output of alloy steels containing chromium. The variety of composition and the multiplicity of uses of the many chromium alloys is so extensive that only a brief résumé of the recent developments will be made here.

Nirosta metal (18 per cent of chromium and 8 per cent of nickel) was the outstanding product of the alloy steel market in 1929. This material was substituted for the plated parts of the Ford automobile and was used for decorative purposes in the Chrysler and Empire State buildings in New York City. The success or failure of the Ford experiment will have much to do with the future of chromium plating in the automobile industry. During 1929 the world output of Nirosta metal was estimated at 30,000 to 35,000 tons, 30 per cent of which was utilized by the Ford company. The cost of the finished alloy was about 40 cents a pound. Tests were made by the Rhinelander Paper Co. with Nirosta metal and an alloy containing 25 to 30 per cent of chromium and 1 per cent of manganese. The two materials successfully resisted corrosion by sulphite liquors and other sulphur compounds. Previous experiments indicate that these alloys resist nitric acid and many organic compounds as well as many other corrosive agencies to various degrees.

The use of ordinary stainless steels (10 to 14 per cent of chromium and 0.1 to 0.2 per cent of carbon) in cutlery and other equipment subjected to moderate temperatures and corrosion by atmospheric and organic acids increased. Stainless steel can be substituted for Nirosta metal in many applications where cost is vital, the former costing only 20 to 25 cents as compared with 40 cents a pound for the latter.

A new series of alloys containing 17 to 20 per cent of chromium and 6 to 10 per cent of manganese has been developed and was recently described by Dr. F. M. Beckett.[3] The addition of 6 per cent of manganese to a 17 or 18 per cent chromium steel increases its strength, toughness, and deep-drawing properties. Higher percentages of manganese enhance elongation and reduction of area properties. This series of steels is believed to have several properties in common with Nirosta metal.

A manganese-chromium iron welding rod known as "hascrome" was developed during 1929 as an adjunct to the stelliting process, used in building up worn parts to their original shape. "Hascrome" is a cheaper alloy than stellite and is particularly fitted by its composition to serve as a base metal for stellite. The mild steel formerly used for the base metal would usually mushroom under the stellite coating when the piece was subjected to shocks and abrasive wear. The composition of the common types of product of the "stellite" group is shown below:

	Chromium	Nickel	Cobalt	Tungsten	Molybdenum
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1	15–30	35–70		5–25	0–9
2	20–35		30–80	0–20	0–9
3	20–30		30–60	20–25	
4[a]	30	34–35	34–35		

[a] Bario metal.

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[3] Beckett, F. M., Chromium-Manganese Steels: Am. Metal Market, vol. 36, June 17, 1930, p. 10.

The main high-speed, heavy-cut tool steels of 1929 were probably the tungsten-chromium alloys containing 12 to 19 per cent of tungsten; 2.9 to 5.5 per cent of chromium; and variable amounts of manganese, vanadium, and other elements. Such tools can be run at a "cherry-red" heat without losing their cutting edge ("red-hardness"). These alloys are costly and troublesome when treated with heat. Tungsten carbide tools were offered as one of the substitutes. For medium-duty work the chromium-carbon and chromium-carbon-vanadium (or tungsten) low-content alloys are commonly used.

The heat-resistance alloys are becoming more important with the tendency of the petroleum-refining and chemical industries to utilize higher temperatures and pressures. The compositions of some of the common alloys of this type are shown below:

	Chromium	Nickel	Iron	Carbon
	Per cent	*Per cent*	*Per cent*	*Per cent*
1	16–20	Trace– 0.5	(1)	0.15–0.40
2	22–30	Trace– .5	(1)	.15– .35
3	17–20	7–10	(1)	.15– .35
4	22–30	8–16	(1)	.20– .55
5	16–22	18–28	(1)	.15– .40
6	10–17	30–36	(1)	.25– .40
7	8–12	21–39	(1)	.10– .35
8	8–16	54–76	(1)	(2)
9	20–28	60–70	(1)	(2)
10	15–30	59–85	Nil.	(3)

(1) Remainder.
(2) Variable.
(3) May or may not be present.

During the last two years a series of chromium-molybdenum steels (1 per cent of chromium, zero to 0.5 per cent of molybdenum, and 0.2 to 0.5 per cent of carbon) has been developed for use in the bracing of wings, fuselage, and engines on aircraft and for structural parts of locomotives, automobiles, and similar machines. Such alloys are readily weldable, strong, durable against torsional stress, and fairly noncorrosive.

The low-content chromium-nickel, chromium-vanadium, etc., steels are quite popular for structural uses requiring high tensile strength, toughness, and lasting qualities, and chromium-copper steels are being tried for rails.

REFRACTORIES

The increased importation of ores of refractory grade indicates an increased use of chromite refractories (brick and cement) during 1929. These ores come largely from Greece, Cuba, and the Union of South Africa.

During 1929, a new high-temperature cement, adachrome,[4] was developed. The makers claim that, because of its chromite base, the cement is chemically inert and is a hard, dense refractory. It is said to be resistant to basic and acid slags; molten-metal penetration; and abrasion, erosion, and chemical action brought about by burning acid sludge. It is also stated that when it is applied as a surface coating on boiler settings, it protects the brickwork from the penetrating action of clinker and fusible coal ash. The material is sufficiently plastic to be used for mortar in the laying of various types of brick.

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[4] Arizona Mining Journal, vol. 13, No. 17, Jan. 30, 1930, p. 54.

Refractories similar to adachrome include kromepatch, plastic K–N, grefco, etc.

A second new development in the industry was the addition of diaspore to chromite in the making of a new plastic chromite cement. The diaspore is said to increase the spalling resistance of the refractory.

Chromite bricks are being used more and more in blocks, front walls, and bulkheads of furnaces and are said to be replacing magnesite to a considerable extent in new bottoms.

The quoted price of chromite bricks remained constant at $45 per short ton, f. o. b. shipping point. Magnesite brick, the principal competitor, remained at $65 per short ton, f. o. b. plant, for 9-inch straights.

CHEMICALS

CHROMIUM PLATING

The electroplating industry realized a fine year in 1928, and 1929 appears to have been even better as far as volume of plated material produced and widening of scope of uses were concerned. Investigators have estimated that over 500 tons of chromium [5] were electrodeposited on over 2,000 kinds of articles.[6]

Much advance has been made in the technology of electroplating and in the uniformity of the product. Larger units and automatic control have aided in reducing costs and improving products. One of the essential factors in the advance of a given commodity is the creating of public interest in that commodity, and this seems to have been done.

The following recent papers give valuable information relative to standard American practice:

1. Schneidewind, Richard, Chromium Plating Patents. The Metal Industry, Jan. 20, 1928, pp. 89–92.
2. Harding, H. E., and Barrows, W. P., Electrodeposition of Chromium from Chromic Acid Baths. Tech. Paper 346, Bureau of Standards, Department of Commerce, Washington, D. C., 1927.
3. Farber, H. S., The Throwing Power on Chromium Plating. The Metal Industry, vol. 28, No. 3, March, 1930, pp. 124–125.
4. Schneidewind, Richard, A Study of Chromium Plating. Eng. Research Bull. 10, University of Michigan, Ann Arbor, Mich., 1928, price $1.
5. Chromium Plating, Ann. Convention of American Electro-Platers' Society, Toledo, Ohio, June 30, 1927.
6. McCord, W. W., The Present Situation as Regards Chromium Plating. The Metal Industry, November, 1929, pp. 521-522.
7. Faris, C. H., Application of Electro-deposited Metals to Engineering. Iron and Coal Trades Review, Jan. 4, 1929, p. 5.
8. Freeman, Benjamin, and Hoppe, F. E., Electroplating with Chromium, Copper, and Nickel. Prentice-Hall, Quebec. (Copies obtainable from the Am. Metal Market, 111 John Street, New York City, price $5.)

The Nast process [7] of direct plating, which does away with the usual preliminary stage of plating with nickel or other metals, has been developed in Great Britain. Adhesion of chromium to the base metal has been reported to be better than adhesion of nickel. Another advantage claimed by the inventors is the time saved, as it takes only 10 minutes for chromium plating whereas it requires 40 minutes for nickel plating. This saving of time is said to represent a large saving in operating costs and in plating equipment. Stainless steel is used as a base metal. The harness of the coating is regulated by the current density and can be increased by burning. The maximum hardness desired is 9.5 due to the difficulty of polishing when the coat is too hard.

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[5] Mining and Metallurgy, vol. 11, No. 277, January, 1930, p. 45.

[6] Kerrigan, J. J., Chromic Acid, Increase in Production: Chem. and Met. Eng., vol. 37, No. 1, January, 1930, p. 52.

[7] Chemical and Metallurgical Engineering, vol. 37, No. 3, March, 1930, p. 176.

English practice was adequately summarized in a recent article.[8]

Two processes, the "autochrome" and Jirotha, have been developed recently and may offer serious competition to electroplating.

The autochrome process [9] was discovered during 1929, and the following quotation gives a brief résumé of the process:

> Following upon the success achieved in calorizing iron and steel tubes by the autodoublage process to resist very high temperatures, the same inventors turned their attention to developing a method to convert ordinary iron or steel into chromium iron or steel by the direct use of chromium ore, thus obviating the increase of carbon content in the original product treated. The result was the autochrome process, recently developed in France where a small unit is now in operation. This plant is said to be treating iron and steel rods, bars, plates, and strip as well as cast iron.
>
> The cost is very low and it is claimed that the resulting product is stainless and will take a good polish. If what the inventors claim for the process is true there is a large potential use for their products.
>
> The method is said to follow somewhat the same lines as the autodoublage process in that with the chrome ore is mixed either nickel chloride or a cobalt chloride. Penetration of the article treated is said to extend practically through to the center.

The Jirotha process,[10] recently developed in Europe, calls for a protective coating (film), which is obtained by immersion in an aqueous solution of chromates and salts of heavy metals. The process is operated at moderate temperatures.

BICHROMATES AND CHROMATES

Imports of potassium chromate and bichromate amounted to 8,880 pounds valued at $1,537 in 1929 as compared with 6,866 pounds valued at $1,112 in 1928. Sodium chromate and bichromate amounted to 350 pounds valued at $80 in 1929 as compared with 1,752 pounds valued at $287 in 1928. Exports of sodium chromate and bichromate amounted to 5,855,293 pounds valued at $396,855 in 1929 as compared with 8,692,088 pounds valued at $560,777 in 1928.

A method for the production of chromates with simultaneous recovery of alumina has been patented by Heinrich Specketer and Georg Henschel, Griesheim, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany (United States Patent 1760788).[11]

PIGMENTS

The chrome yellows and greens were favored during 1929 and consumption is said to have increased. During 1929 chrome yellow, c. p., was quoted [12] at 16 cents per pound in January and 17 cents in December, and chrome commercial green was steady at 6¼ cents per pound throughout the year. C. p. green has been stable since January, 1927, at 27 cents.

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[8] The Iron and Coal Trades Review, Present Position of Chromium Plating (a recent discussion in London at the meeting of the Electroplaters' and Depositors' Tech. Soc., held at the Northampton Inst., London, on Jan. 31, 1930): Vol. 120, No. 3232, Feb. 7, 1930, p. 238.

[9] Sharpe, A. J., The Autochrome Process: Eng. and Min. Jour., vol. 128, No. 20, Nov. 16, 1929, p. 769.

[10] Metal Industry, vol. 28, No. 4, April, 1930, pp. 175–176.

[11] Chemical and Metallurgical Engineering, vol. 37, No. 6, June 30, 1930, p. 384.

[12] Oil, Paint and Drug Reporter, Review No., vol. 117, No. 6, Feb. 6, 1930.

PRICES[13]

The quoted price for 46 to 47 per cent Rhodesian and Indian ores, f. o. b. eastern shipping points, was $22 a long ton during the first seven months, but in August a drop of $0.50 took place and the price remained steady at $21.50 until the end of the year. Indian and Rhodesian 50 to 51 per cent ore was quoted at $23.50 until May when the price fluctuated from $23.50 to $24.50 and continued at $24.50 in June and July. This price was followed by a decrease to $23.50 in August, September, and October. However, it increased to $24 in November and December. New Caledonian high-grade ore was steady at $25 throughout the year.

Ferrochromium containing 60 to 70 per cent of chromium and 4 to 6 per cent of carbon was quoted at 11 cents per pound of contained chromium on required lots. Spot shipments commanded an extra half cent. Ferrochromium, containing 60 to 70 per cent of chromium and under 2 per cent of carbon, was quoted on the open market for spot delivery for the first time in December, at 19 cents per pound of contained chromium.

Prices of other chromium commodities are taken up under other headings.

WORLD ASPECTS

WORLD PRODUCTION OF CHROMITE IN 1929

The estimated production of chromite in 1929 was 600,000 metric tons as compared with 450,000 tons in 1928, an increase of 33 per cent.

Southern Rhodesia again led the world with a production of 265,909 metric tons or 44 per cent of the world total, an increase of nearly 34 per cent as compared with 199,060 tons during 1928. The Union of South Africa rose to second place, with an output of 63,974 tons, more than double the production reported for 1928 and 10.7 per cent of the world total for 1929. New Caledonia was third with an export of 59,147 metric tons, about 10 per cent of the world total, an increase of about 4 per cent as compared with 56,902 tons in 1928. Cuba furnished 9 per cent of the total, or 53,799 metric tons, an increase of 57 per cent over 1928. India increased its production of the year before to 50,361 tons, or about 8 per cent of the world total for 1929. The production of chromite in Yugoslavia has been increasing rapidly for the past few years and in 1929 was 43,022 metric tons, as compared with 16,678 tons in 1928, an increase of more than 150 per cent. Turkey's output in 1929 was 15,078 tons, an increase of 27 per cent over production in 1928. Cyprus, Indo-China, and Australia resumed production, and Japan probably continued about as before. The only decrease actually reported was in the United States, which shipped only 273 metric tons as compared with 671 the year before.

This augmented 1929 production is attributed to the increased use of chromite in the manufacture of steel, refractories, and chromic acid for the electroplating industry. The use of chromite in pigments and other chemicals probably remained the same or increased somewhat.

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[13] Engineering and Mining Journal, monthly quotations.

The following table shows the world production of chromite from 1925 to 1929:

Production of crude chromite, 1925–1929, by countries, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1925	1926	1927	1928	1929
Australia	978	607	----------	----------	131
Brazil [1]	----------	1,500	1,820	20	70
Cuba [2]	30,309	36,598	17,256	34,248	53,799
Cyprus [1]	2,021	524	711	----------	842
Great Britain	455	----------	384	----------	----------
Greece	8,079	20,049	17,314	20,953	(3)
Guatemala [2]	----------	54	----------	----------	----------
India (British)	38,053	33,918	58,125	46,185	50,361
Indo-China	----------	----------	----------	----------	11
Japan	5,823	7,052	9,782	9,808	(3)
New Caledonia	34,732	34,267	[1] 42,885	56,902	[1] 59,147
Norway [1]	440	17	----------	----------	(3)
Russia [4]	30,111	30,362	19,294	21,967	(3)
Southern Rhodesia	123,220	164,376	197,782	199,060	265,909
Turkey (Asia Minor)	7,506	6,670	18,318	11,849	15,078
Union of South Africa	13,756	12,042	16,959	31,756	63,974
United States (shipments)	110	143	204	671	273
Yugoslavia	12,160	15,983	8,757	16,678	43,022
	307,753	364,162	409,591	450,097	600,000

[1] Exports.

[2] Imports into the United States.

[3] Data not available.

[4] Data for year ended Sept. 30.

WORLD TRADE IN CHROMITE IN 1928

A review of the figures of the flow of chromite in 1928, the latest year for which final data are available, shows that the six main producing countries consume little chromite and that the main consuming countries, except Russia, produce only negligible amounts. These facts illustrate how an important manufacturing industry may depend largely upon imported raw materials.

The production of chromite in 1928 amounted to 443,000 long tons, of which nearly 87 per cent was produced by Rhodesia, New Caledonia, British India, Cuba, the Union of South Africa, and Russia. The world total exports amounted to about 361,500 long tons, 90 per cent of which was exported by the above countries. The total imports amounted to around 350,000 tons, of which the United States, Germany, Sweden, the United Kingdom, Norway, and France took 95 per cent. These same countries consumed 86 per cent of the chromite used during the year. Russia, Yugoslavia, and Japan were the only consuming nations that were able to produce enough chromite to meet their needs. The following table shows the amount of chromite produced, exported, imported, and consumed by principal countries in 1928, in long tons.

Chromite produced, exported, imported, and consumed by the principal countries in 1928, in long tons

[The figures show the actual and relative position of producing countries in world production and exports of chromite in comparison with actual and relative imports and apparent consumption in principal countries]

Country	Production	Per cent of total	Exports	Per cent of total	Imports	Per cent of total	Apparent consumption [1]	Per cent of total
	Long tons		*Long tons*		*Long tons*		*Long tons*	
Southern Rhodesia	195,900	44.2	162,300	45.0				
New Caledonia	56,000	12.6	56,000	15.5				
British India	45,500	10.3	45,300	12.5			200	0.1
Cuba	33,700	7.6	33,700	9.3				
Union of South Africa	31,300	7.1	23,400	6.5				
Russia	21,600	4.9	3,000	.8			18,600	4.8
Greece	20,600	4.7	17,000	4.7			800	.2
Yugoslavia	16,400	3.7	9,100	2.5			7,300	1.9
Turkey	11,700	2.6	11,700	3.2				
Australia			(2)	(2)				
Japan	9,700	2.2			(3)	(3)	9,800	2.5
United States	660	.1			216,600	61.8	217,300	56.0
Brazil	20		(2)	(2)				
Germany					45,800	13.1	45,800	11.8
Sweden					27,600	7.9	27,600	7.1
United Kingdom					22,400	6.4	22,400	5.8
Norway					12,400	3.5	12,400	3.2
France					[4] 8,000	2.3	[4] 8,000	2.1
Czechoslovakia					2,400	.7	2,400	.6
Other countries			(2)	(2)	[3] [4] 15,200	4.3	[4] 15,000	3.9
	443,000	100.0	361,500	100.0	350,400	100.0	387,600	100.0

[1] Producers' and consumers' stocks not taken into account except in the case of Southern Rhodesia and the Union of South Africa, where consumption is negligible.

[2] A few hundred tons of exports from Brazil, Australia, and "Other countries" unaccounted for.

[3] A few hundred tons imported into Japan included in the estimate for "Other countries."

[4] Estimated.

SUMMARY OF PRODUCTION AND CONDITIONS IN THE PRINCIPAL CHROMITE PRODUCING AND CONSUMING REGIONS OF THE WORLD

NORTH AMERICA

CANADA

No production was reported by Canada during 1929, but prospecting and development work were carried out in several areas. The Consolidated Mining & Smelting Co.[14] at the Chrome Creek property, near Ashcroft, British Columbia, has been diamond drilling its claims and doing some trenching. It is said to have shipped 126 tons of ore to its plant at Tadanac for experimental purposes.

The Consolidated Chromium Corporation,[15] an American concern, has done considerable diamond drilling and other development work on its property near Collins, Ontario, and, according to the operators, several million tons of ore averaging 16 to 38 per cent of Cr_2O_3 has been disclosed. The deposit is estimated to be about 18,000 feet in length and 600 feet wide, of which only a part is classed as commercial. The company proposed to construct a concentrator that will eventually handle 4,000 tons of ore daily and to build a 20-mile railway connection.

Deposits in other parts of Canada are receiving attention, but results have not been published to date.

A subsidiary of the Shawinigan Water & Power Co., known as the Shawinigan Stainless Steel & Alloys Co. (Ltd.), is beginning operations at Shawinigan Falls. This plant is the first in Canada to concentrate upon the manufacture of alloy-steel castings of all descriptions.

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[14] Canadian Mining Journal, vol. 51, No. 19, May 9, 1930, p. 449.

[15] American Metal Market, vol. 37, No. 12, Jan. 17, 1930, p. 9.

CUBA

Imports of chromite into the United States from Cuba, which represent the total shipments from Cuba, amounted to 52,949 long tons in 1929 as compared with 33,707 tons during 1928, an increase of 57 per cent. Most of the increase came from the Camaguey deposits which produced 40,380 long tons in 1929 as compared with 22,306 tons in 1928. No production was obtained from the Caledonia mine which is said to have been exhausted, but 12,842 long tons of ore was shipped from stocks. The Caledonia ore averages about 43.9 per cent of Cr_2O_3, 11.8 per cent of iron, and 8.2 per cent of silica, whereas the ore from the Camaguey region averaged about 33 per cent of Cr_2O_3, 11.3 per cent of iron, 3.3 per cent of silica, and about 28 per cent of Al_2O_3 (relatively high). Practically all of the ore is used in the manufacture of refractories, but in the past some of the higher grade material was used in the making of ferrochromium.

The Bethlehem Cuba Iron Mines Co. which controls the Camaguey deposits is said to have acquired seven new concessions, comprising some 267 acres, and to have opened up three new mines. The reserves are reported to be fairly large and of about the same grade as the ore mined in 1928 and 1929 at Camaguey. This company is said to have mined and shipped about 130,000 tons of ore since 1924, when the mines were reopened after the postwar slump.

The Cuban Industrial Ore Co. has been operating mines near Alta Gracia, and from 1923 to the end of 1929 about 60,000 to 65,000 tons of ore was mined and exported to the United States through the port of Pastelillo (Nuevitas). The ore is of refractory grade and contains 30 to 35 per cent of Cr_2O_3.

A new prospect has been opened up in the Province of Matanzas which is expected to come into production as soon as a market for the ore can be developed. The ore runs about 44 per cent of Cr_2O_3.

The total shipments from Cuba from 1916 to 1929, inclusive, have been about 213,000 tons.

The Bethlehem Cuba Iron Mines Co.[16] did not produce in the Mayari field in 1929, as it had sufficient nodulized ore in stock. Approximately 48,500 tons of this material was shipped to the company's plant in Maryland during 1929. The port of exit is at Felton, on Nipe Bay.

GUATEMALA

It has been reported that an American concern has entered the field in Guatemala[17] and that it proposes to ship high-grade chromite some time in the near future. The deposits are located at Potrero, Carillo, and Patachu, in the Department of Jalapa, 100 miles inland from Puerto Barrios, the nearest shipping point. Over 4,500 long tons of chromite was shipped to the United States from 1917 to 1921, inclusive. This ore averaged 58 per cent of Cr_2O_3.

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[16] Porter, L. C., Cuba: Eng. and Min. Jour., vol. 129, No. 3, Feb. 8, 1930, p. 149.

[17] Donald, G. K., Review of Commerce and Industries for the quarter ended Mar. 31, 1930: Consular Rept. 333399, Guatemala City, Guatemala, Apr. 12, 1930.

EUROPE

FRANCE

France produces no chromite and is dependent on foreign sources for its supply. Exact data on the quantity imported are not available as chromite is not reported separately in the French import statistics. The following table shows exports of chromite to France from various countries in 1928.

	Metric tons
India	4, 724
Southern Rhodesia	2, 377
South Africa	486
Yugoslavia	290
	7, 877

French manufacturers of ferrochromium have competed with other European manufacturers for the French steel trade. The Iron and Coal Trades Review [18] summarizes the situation as follows:

> Although the official prices quoted in France for ferrochromium have not changed for several months, actual selling prices have been steadily decreasing. Thus, for instance ferrochromium, 8 to 10 per cent C, which was quoted at 3,050 francs per ton, is currently sold at 2,500 francs delivered. The customs dues (400 francs per ton for over 2 per cent C grade and 540 francs per ton for the 0.70 to 2.0 per cent C grade) are high but have not of late been sufficient to prevent active competition from outside sources. Negotiations are in progress for the forming of an international comptoir for ferrochromium among German, Swiss, and Scandinavian producers, but thus far the French producers have been reluctant to join.

The Scandinavian ferrochromium producers (Norway and Sweden) are said to be able to undersell the French manufacturers, and this fact may force the French into the cartel which has been proposed. In 1928 France imported 6,429 tons of ferrochromium and 3,117 tons of bichromates.

GERMANY

Germany is the second largest consumer of chromite in the world but has to import all of its needs, only a few scattered and low-grade deposits having been found there. The following table shows the origin of German imports during 1928.

	Metric tons
British South Africa	20, 088
British India	8, 527
New Caledonia	7, 268
Australasia	2, 834
Spain	3, 716
Yugoslavia	1, 669
Portuguese East Africa	1, 144
Russia	845
Greece	42
Others	476
	46, 609

Of this amount a small tonnage is exported to other countries. In Germany a large part of the chromite goes into ferrochromium as in the United States; the remainder is made into chemicals and refractories. About 8,512 tons of bichromates and oxides were exported in 1928 and only 207 tons were imported. Germany exports bichromates to Great Britain, France, Netherlands, Spain, and British India.

GREECE

The production of chromite in Greece during 1928 amounted to 20,953 metric tons, as compared with 17,314 metric tons in 1927. Shipments aggregated 18,911 tons in 1928. The largest producer was the Société Union Minière, at Alchani Domokos, which produced over half of the total output. Apostolides Frères, at Pharsala, and George El Polygenis, of Ardouan, produced practically all of the remainder.

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[18] Iron and Coal Trades Review, London, vol. 120, Jan. 3, 1930, p. 23.

The following table shows the exports of chromite from Greece by countries for 1928 and 1929.

Chromite exported from Greece, 1928 and 1929, in metric tons

Country	1928	1929
Belgium	100	
United States	12, 750	17, 170
Others	4, 412	2, 951
	17, 262	20, 121

Imports into the United States from Greece amounted to 26,647 long tons in 1929 as compared with 17,152 during 1928, an increase of about 9,500 long tons.

In 1928, 59,663 tons of chromiferous iron ore was mined at Tsouka by the Société des Mines d'Atalanti and at Loutsi by the Société Internationale des Mines. Shipments amounted to 104,995 metric tons, which included some ore shipped from stocks at Larimna by the Société Minière Lokris.

NORWAY

Norway imported 11,748 metric tons of chromite in 1929, as compared with 12,640 tons in 1928. The following table shows the imports of chromite into Norway in 1928 by countries of origin.

	Metric tons
British South Africa	2, 245
East Africa	3, 087
British East India	3, 341
United States	3, 101
	11, 774
Other countries	866
	12, 640

Practically all of the chromite was used in the manufacture of ferrochromium and bichromates. The ferrochromium is made in electric furnaces owing to the cheap hydroelectric power available. Norway exports ferrochromium to many European countries.

RUMANIA

The deposits of chromite in southern Banat [19] are now considered of importance because of their favorable location. They lie 2 to 10 kilometers from the Danube, thus making water transportation available. The ore occurs in large masses in serpentine, which sometimes contain as much as 200,000 tons. The chromite averages about 32 to 52 per cent of Cr_2O_3 and 16 to 29 per cent of FeO; the deleterious impurities are readily removed. The reserves have been estimated at approximately 10,000,000 tons.

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[19] L'Industrie Chimique, Paris, 16th year, No. 188, September, 1929, p. 1. (Appendix.)

These mines were discovered in 1757, but the presence of chromium in the material was not disclosed until many years afterwards because the ore was mistaken for copper ore on account of its green color. A German concern produced about 40,000 tons during the war from mines at Dubova and Plavisevitza. No production has been reported since 1923.

RUSSIA (UNION OF SOCIALIST SOVIET REPUBLICS)

During the fiscal year ended September 30, 1929, Russia produced about 28,000 metric tons of chromite, an increase of 27 per cent over the previous year but 8 per cent less than in 1926. During the fiscal year 1927 Russia consumed approximately 21,000 tons of chromite, three-fourths of which was used in the metal industries and one-fourth in the chemical industries. Russia produced no ferrochromium in 1927 as the ore was used directly in the manufacture of steel and iron. The principal chemical products are sodium bichromate, chrome, soda alums, and potassium bichromate.

Russia produces some chromite in excess of its needs. During the past three fiscal years the following amounts of high-grade ore (48 per cent of Cr_2O_3) have been exported.

	Metric tons
1927	2, 328
1928	2, 981
1929	5, 055

Comprehensive data on the chromite resources of Russia are not available, but owing to the large areas of basic rocks in which chromite is often found the resources of Russia will probably prove large. In recent years the Soviet Government has been very active in prospecting for and developing new deposits.

Deposits of chromite are known to exist in the Ural area, northern Caucasus, Transcaucasia, and Transbaikalia. The Ural deposits which are the only ones of commercial importance at present are found in serpentines and soapstones and extend from Perm southward into Orenburg. The reserves of this area have been estimated at 6,000,000 tons.[20]

It has been estimated that the largest of these deposits, Saranovsky, near Perm, contains 180,000 tons of developed ore, 541,000 tons of probable ore, and 736,000 tons of possible ore, a total of 1,457,000 tons containing 40 to 50 per cent of Cr_2O_3. There is also considerable lower-grade concentrating ore. Second in importance is the Gologorsky deposit, near Sverdlovsk. A concentrating plant was built at this property in 1914, but operations were suspended and were not resumed until 1926. Concentrates average 42 to 48 per cent of Cr_2O_3, and are mainly utilized by the Shaitansky bichromate-manufacturing works.

Numerous deposits have been discovered recently in the Khalilovsky region which extends into the Orenburg territory. These deposits are of higher grade than other Ural deposits, and in many cases the ore can be shipped directly.

Other Ural deposits are the Novoe Delo in the Monetnoi district; the Kliuchevsky group of mines in the Revdinsky section; and the deposits at Samokhvalovsky-Kozlovsky, Nizhne-Isetsky, Kyshtimsky, and Kaslinsky estates. In the Zlatoustovsky district a concentration plant is planned to work the ores of the Ubalinsky and lesser deposits in the Miassky region and the Troitsky district. The ore in these deposits contains between 20 and 41 per cent of Cr_2O_3.

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[20] Annual Review of the Mineral Resources of the Union of Socialist Soviet Republics for 1926–1927, pp. 1054–1060.

According to V. Kozlov, the Beloretzky Mining Trust in 1927 was mining a deposit of high quality on the eastern slope of the Ak-bik Mountain, in the Bashkirian Autonomous Province. The mines are located 5 to 6 kilometers southwest of the village of Shigaev and 30 kilometers from the Beloretzky plant where the ore is being used in the manufacture of bichromate.

Many chromite deposits have been found in northern Caucasus and Transcaucasia, but as yet there has been little production. Recently, chromite associated with tin ore was found on Dzhumarakli-Tuba Mountain in the Arkhyzky region, northern Caucasus. Many deposits have been found in Siberia especially in the Lake Baikal area, but these also have not produced to date.

The following table shows the production of chromite in Russia by regions for 1913 and 1923 to 1927, in metric tons.

Region	1913	1923[1]	1924[1]	1925[1]	1926[1]	1927[1]
Ural Province	24, 920	875	8, 773	22, 117	26, 622	13, 015
Government of Orenburg	-	-	-	87	-	-
Bashkirian Autonomous Republic	1, 296	17	3, 121	4, 991	3, 740	6, 279
Kazaksky Autonomous Republic	-	-	-	2, 916	-	-
	26, 216	892	11, 894	30, 111	30, 362	19, 294

[1] Year ended Sept. 30.

SWEDEN

Sweden produces no chromite but imported 28,077 metric tons during 1928; the ore came from the following countries:

	Metric tons
United Kingdom	23, 346
Germany	3, 345
British India	502
Belgium	314
Russia	280
Netherlands	140
United States	79
Greece	61
Others	10
	28, 077

This chromite is used for the manufacture of ferrochromium and with iron ore to make stainless steel directly.

UNITED KINGDOM

As the Shetland Islands have not produced chromite for two years the United Kingdom relies on imports for its entire needs. In 1928 about 22,400 tons were imported and were used chiefly in the steel industry. The following table shows the imports of chromite into Great Britain by countries of origin, 1928.

	Long tons
Portuguese East Africa	11, 064
Southern Rhodesia	5, 403
Portuguese India	2, 037
British India	1, 824
Other British colonies	1, 250
Belgium	691
Others	117
	22, 386

Imports during the past five years have been as follows:

	Long tons		Long tons
1924	26, 120	1927	17, 773
1925	21, 040	1928	22, 386
1926	7, 063		

The United Kingdom imported 2,580 tons of bichromates during 1928 but exported 3,484 tons, a net export of 904 tons. Ferrochromium manufactured in the United Kingdom is largely used at home, and only a relatively small amount is imported or exported.

YUGOSLAVIA

Yugoslavia produced 43,022 metric tons of chromite during 1929, as compared with 16,678 tons in 1928 and 8,757 tons in 1927. In 1928 about 9,200 metric tons were exported to the following countries:

	Metric tons		Metric tons
Austria	1, 828	Greece	2, 448
Czechoslovakia	1, 261	Hungary	346
Egypt	110	Switzerland	1, 760
France	290		
Germany	1, 205		9, 248

ASIA

INDIA

The production of chromite in India during 1929 increased 4,110 long tons, the larger part of the increase being in Baluchistan. The production in 1929 was 49,565 long tons, as compared with 45,455 tons in 1928. Exports in 1929 amounted to 32,302 tons, as compared with 45,308 tons in 1928. In 1929, 18,059 tons were exported through ports of British India, and 14,243 tons were exported through the port of Portuguese India (Mormugão), whereas in 1928, 31,209 tons were exported through ports of British India and 14,099 tons through Mormugão.

The increase in production was accompanied by a slight increase in value per ton from Rs. 16.8 in 1928 to Rs. 17.0 in 1929. (1 rupee equals about 36 cents.) The following table shows the quantity and value of the chromite produced in India by districts during 1927, 1928, and 1929.

	1927		1928		1929	
	Long tons	Value	Long tons	Value	Long tons	Value
Baluchistan:						
Zhob	14, 534	£16, 270	15, 002	£16, 793	17, 905	£19, 908
Bihar and Orissa:						
Singhbhum	2, 552	3, 689	2, 165	3, 653	3, 149	5, 107
Mysore State:						
Hassan	34, 030	36, 423	23, 639	28, 806	22, 799	27, 756
Mysore	6, 091	9, 361	4, 649	7, 887	5, 712	10, 047
	57, 207	65, 743	45, 455	57, 139	49, 565	62, 818

British Indian chromite exported in 1928 went largely to France, United States, United Kingdom, and Sweden.

JAPAN

Japan produced 9,808 metric tons of chromite in 1928 as compared with 9,782 tons in 1927. The ore is largely from the Wakamatsu district in the Province of Hoki and averages 40 per cent of Cr_2O_3. Other deposits have been found on the upper courses of the Mukawa River in the Province of Iburi. The total output is consumed at home. In Japanese import statistics chromite is not reported separately.

PHILIPPINE ISLANDS

Large quantities of chromiferous-nickel iron ores of the Mayari type have been known in these islands for a long time, and some investigators believe that further prospecting may reveal the presence of high-grade ore. It has been rumored that exposures of such ore have been disclosed, but information as to the extent and grade of the ores has not been published.

TURKEY

The production of chromite in Turkey during 1929 amounted to 15,078 metric tons as compared with 11,849 tons in 1928 and 18,318 tons in 1927. Various groups have competed for control of the Turkish deposits and the situation in June, 1929, was summarized as follows:[21]

> Probably the most valuable mines are those of Keshish Dagh, near the newly constructed railway line between Kutahia and Tavshanly; of this group the best known are the mines of Dagh Ardy, which are about to be opened. Although the estimate of 400,000 tons made by some prospectors seems excessive, these mines undoubtedly contain large deposits of superior quality ore, averaging about 50 to 52 per cent. Exploited by the German firm of Roechling, of Saarbrucken, these properties now supply yearly about 14,000 tons. Adjoining mines of Kozludja and Karlijer, formerly Krupp concessions, were exploited during the war by the German military mission, and since that time have not been worked. Recently these mines were also taken over by the Roechling firm; and about 7,000 tons of ore stored there since the end of the war will be shipped.
>
> The ore found near Adalia is also remarkable in quality, containing 50 per cent or more chrome. An important region lies south of that town. Here is the district of Ala Tshesme, comprising three mines: Tatas Bunar, Ala Tshesme, and Tshoplu Tepe; the district of Markis, Dagh, with four mines: two near Kutshuk-Tsham Kurtaran, and one mine each near Bujuk-Tsham-Kurtaran and Hemar Dere. At Teken Ova are the following 10 mines: Janar Dagh, Buntshuklu, Sandali, Add Buku, Tekir Ova, Buku, Beydjik, Karga Janik, Utsh Tepe, and Tsheshu; and at Kuza is another mine. These comprise altogether 18 mines in this region, none of which is being exploited.
>
> Between Adalia and Alaja, on the way to Mersina, is another district abundant in chrome. In this region, inclosed by the mountain of Shimshirli Tepe, the village of Kara Burun, the river Bugusik Tshai, and the village of Sasagh Ini, are 16 mines, most of which contain high-grade ore. These properties also have not been exploited, and each requires preliminary prospecting. The situation in the district of Makri west of Adalia is different. This region is held as a concession by the French "Société Minière de Fethié," which is selling from its mines the well-known Makri ore.
>
> At present the most interesting part of Anatolia, so far as chrome is concerned, is the region near Eskishehir. In all, 12 mines were found, some in the immediate vicinity and others at the mountain Tash Tepe and south of Brussa. The grade of the ore ranges from 43 to 50 per cent. In this region the United Swedish Steel Works holds two mining claims and intends to exploit four other mines. This company is first systematically prospecting the mines near Eskishehir, Kosfindik, and Edrenos. Results obtained reveal considerable quantities of ore close to the

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[21] Von Engelmann, H., Turkey Extending Railroads to Develop Chrome Resources: Eng. and Min. Jour., vol. 127, No. 26, June 29, 1929, pp. 1037–1038.

surface that can be reached by simple extraction methods. Attracted by the results this Swedish firm obtained, the aforesaid German firm of Roechling also began exploring in the same region and has obtained control of areas encircling those being developed by the United Swedish Steel Works. In turn, the last-named company is becoming interested in the Roechling sphere of operations near the Keshish Dagh mountain. Third, a French group is also showing interest in the mines of the district of Eskishehir. The mines further north in the district of Bosular, Vilayet of Brussa, and the mine near the village of Kaslik, which were ceded to the Turkish Mining Co., have also been acquired by the Roechling Co. Competition in this central region is hence quite active.

In the district of Guleman are many mines containing 48 to 49 per cent ore. Until now exploiting them was impossible owing to the lack of communications. As soon as the railway line between Fewsi Pasha (formerly known as Keller), Malatia, and Diarbekir, now under construction, is completed, they will undoubtedly receive increasing attention.

Naturally, the most important factor in the development of Turkey's chrome resources is that of transportation. As soon as the 3,000-mile railway system planned by the Angora Government is completed, the exploitation of Anatolia's many natural resources should proceed rapidly.

It was later reported [22] that A. B. Basshuff, who works two deposits at Eskischehir, was negotiating with the Brandt Industrial Co. of Stockholm, which now holds about 15 mines in Turkey. Basshuff proposed the formation of a combine that would bring about the merging of the Brandt and Basshuff interests. This deal was evidently consummated as it is reported in the Canadian Mining Journal [23] that the properties around Stamboul and Angora in Anatolia had been acquired by the Swedish Syndicate, Aktiebolaget-Basshuff. Further information [24] indicates that there are ample reserves to meet the requirements of the syndicate members for some years to come. It is reported that the ore will be used for the manufacture of "rustless" iron and steel. Production was scheduled to begin about the middle of 1929.

The high-grade deposit of chromite near Adalia, in southern Anatolia,[25] is expected to reach a productive stage before long. The analyses indicate that the ore is of very high grade, some tests showing as much as 60.9 per cent of Cr_2O_3. Most of the properties in this area have been acquired by the Baschtash, A. G. (Swedish); the Friedrich Krupp, A. G. (German); the London Chrome Co. (Ltd.) (British—Sir Edmond Davis Group); and Dutch interests. Shipments will commence as soon as the railway to the nearest port is completed.

The Société Générale de Mines et Métallurgie (French) [26] has been organized and has begun the development of its chrome mines in the Brussa region.

American interests have been investigating certain Turkish deposits but have not acquired any mines according to information to date.

The estimated total output from Turkish mines to 1929 is about 825,000 tons, or 12.5 per cent of the world total from 1827 to 1928, inclusive. Annual production is expected to increase materially as soon as the proposed railway system is completed. The reserves of chromite are not actually known. Estimates range from 1,000,000 to 15,000,000 tons of ore averaging 50 per cent of Cr_2O_3.

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[22] L'Industrie Chimique, No. 190 (16th year), p. 4.

[23] Canadian Mining Journal, vol. 50, No. 34, Aug. 23, 1929, p. 796.

[24] American Metal Market, July 26, 1929, p. 5, and Metal Bulletin, London, No. 1454, Dec. 20, 1929, p. 15.

[25] Iron Age, vol. 125, No. 18, May 1, 1930, p. 1361.

[26] Metal Bulletin, London, No. 1498, June 3, 1930, p. 11.

AFRICA

SIERRA LEONE

Some promising chromite deposits in Sierra Leone have recently been described by Junner.[27] One is located near the village of Gerihun and is said to contain ore averaging 45 per cent of chromium sesquioxide, which is suitable for the manufacture of ferrochromium. Another deposit, near the village of Jalahun, contains ore of good refractory qualities and averaging about 36 per cent of chromium sesquioxide.

SOUTHERN RHODESIA

Southern Rhodesia is the world's largest producer of chromite, supplying nearly half of the world output. The production comes largely from extensive deposits of high-grade ore (probably the greatest known) which occur along the Great Dyke, a formation of basic and ultrabasic rocks averaging 4 miles in width and traversing the central part of the country in a north-northeast and south-southwest direction for 330 miles.

Preliminary reports indicate that the chromite production of Southern Rhodesia was 293,116 short tons (261,711 long tons) during 1929 as compared with 219,428 short tons (195,918 long tons) during 1928, an increase of 33.6 per cent.

The Gwelo district produced 79 per cent of the 1928 output, the Lomagundi district 16 per cent, the Victoria district nearly 5 per cent, and the Hartley district a small quantity.

The Victoria district is the southernmost of the chrome-producing areas. The principal deposits are at Mashaba, which is about 20 miles east of Fort Victoria, the nearest point on the railroad, and several miles east of the Great Dyke. Lack of cheap transportation has hindered the development of this deposit, but late in 1929 the construction of a railroad extension from Fort Victoria was being considered.

The principal deposit of the Gwelo district, which lies northwest of the Victoria district, is at Selukwe. This deposit has been producing steadily since 1906 and has supplied a large part of the Rhodesian output. The ore occurs along the Great Dyke as lenses in talc schist, chlorite schist, and serpentines. The bulk of the lenses range from 150 to 450 feet in length. Another important producing area of the Gwelo district is Lalapanzi, about 30 miles northeast of Selukwe. The chromite occurs here in three continuous seams paralleling the Great Dyke. The seams dip at an angle of 25° and are 2 to 9 inches wide. The ore ranges in grade from 48 to over 50 per cent. The Gwelo district has adequate rail transportation to the port of Beira, Portuguese East Africa.

The Hartley district lies about 80 miles north of Lalapanzi. In 1929 the Bee Chrome Co. uncovered three seams which appeared to be continuations of three of the Lalapanzi and Umvukwe seams on the south and north, respectively. These seams dip 10° on both sides of the dyke, forming a trough. Two of the seams averaged 8½ inches in width over a large area. The reserves as developed over a length of 76,600 yards and an incline depth of 100 feet were estimated at 3,000,000 tons averaging 49.3 per cent. The ore is transported 43½ miles to Hartley station by trucks and wagons, but a narrow-gage railroad has been proposed. The cost of delivering ore, c. i. f. Europe and the United States, was estimated as between $18 and $19.[28]

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[27] Junner, N. R., Geology and Mineral Resources of Sierra Leone: Min. Mag., London, vol. 42, No. 2, February, 1930, pp. 73–82.

The Lomagundi district, which lies north of the Hartley area, is the second largest producer of chromite in Rhodesia. Several chromite seams, which extend almost continuously from the southern boundary of Darwendale to the vicinity of the Gurungwe farm, a distance of approximately 70 miles, have been found across the whole width of the dyke. The continuity of the deposit apparently is broken near Gurungwe, but ore occurs again further north and is said to be plentiful and of high quality. Owing to lack of rail transportation production in this district has been confined largely to the area immediately north of Darwendale where the railroad crosses the Great Dyke. Recently, deposits at Umvukwe, several miles north of Darwendale, have been developed and appear to contain large quantities of high-grade chromite. Early in 1930, the construction of a branch railway from a point near Darwendale northward along the west side of the dyke was reported. The completion of this railroad should result in a greatly increased production in the Lomagundi district.

Lack of data makes it impossible to appraise numerically the chromite reserves of Southern Rhodesia but one can safely state that the deposits now developed along the Great Dyke, particularly in the Lomagundi and Gwelo districts, are capable of producing several million tons of high-grade ore.

Practically all of the mines in Southern Rhodesia are now owned or controlled by the following companies: Chrome Corporation (South Africa) (Ltd.); Becker Trust Co. (Ltd.); Mann Little & Co.; and Bee Chrome Co. The Chrome Corporation operates the Selukwe mines and has large holdings in the Lalapanzi, Umvukwes, and Mashaba areas. During 1929 this company acquired the holdings of the Great Southern Rhodesia Chrome Co. (Ltd.), the claims of Messrs. Kimpton & Hepker, and a lease on Goddard's Hill near Mashaba. The blocks obtained from the Great Southern Rhodesia Co. are 148 in number and cover 2,700,000 square feet. The Kimpton property comprises about 73 blocks.

The Bee Chrome Co. has recently consolidated its holdings in the Hartley district and now controls 220 blocks of claims, extending from the Umniati River several miles to the north along both flanks of the Great Dyke.

To the end of 1929 Southern Rhodesia produced about 2,137,754 short tons of chromite, or 25 per cent of the world total since 1827.

During 1928 it exported 181,741 short tons which went to the following countries:

	Short tons		Short tons
United States	97, 649	Norway	3, 360
United Kingdom	53, 220	France	2, 620
Holland	10, 125	Others	766
Italy	5, 171		
Portuguese East Africa	4, 462		181, 741
Germany	4, 368		

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[28] South African Mining and Engineering Journal, vol. 40, pt. 2, No. 1996, Dec. 28, 1929, pp. 451–453.

UNION OF SOUTH AFRICA

The production of chromite in the Union of South Africa during 1929 was 70,520 short tons, which averaged 42.58 per cent of Cr_2O_3, as compared with 35,006 short tons in 1928. Exports in 1928 are shown below:

	Short tons		Short tons
United States	11, 672	Germany	534
Holland	10, 794	Belgium	115
United Kingdom	1, 966		
Sweden	552		26, 169
France	536		

The Rustenburg and Lydenburg districts of Transvaal were both active producers in 1929. Their holdings have been consolidated into two main groups controlled by the Chrome Corporation (South Africa) (Ltd.) and the African Chromite Corporation. The Chrome Corporation's annual report [29] describes its Transvaal properties as follows:

> The Transvaal properties comprise freehold of the farm Grootboom Annex, No. 473, in the Lydenburg district and mineral leases over farms Grootboom No. 186, Winterveld No. 424, Doornbosch No. 423, Mooihoek No. 147, in the Lydenburg district, and Boekenhoutfontein No. 336, Bultfontein No. 354, Boschhoek No. 286, and Boschkoppie No. 685 in the Rustenburg district.
>
> Two seams have been opened up on the Grootboom Annex, but only the lower one has been prospected. The ore averaged 43.7 per cent Cr_2O_3 over a width of 46 inches. This was opened up a mile along the strike from the workings on Grootboom. The cost of quarrying was 3s. 10d. ($0.93) a ton and transport and loading cost was 5s. 1.9d. ($1.25), making a total delivered on rail of 9s. ($2.18). The ore is worth 20s. 11d. ($5.08) delivered on rail at Steelport Station which, allowing 1s. 6d. ($0.36) for overhead, leaves a profit of 10s. 15d. ($2.54). The company is now negotiating with the Government of the Union of South Africa for railway extensions to several mines, which should reduce the transport cost.
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> On the Grootboom No. 186 there are two mines fully developed and equipped for the production of 2,000 tons a month and a big reserve of residual ore has been developed north of No. 2 mine. There are two distinct chromite horizons, the upper horizon lying from 25 to 40 feet above the lower. The horizons have a thickness of 4 to 12 feet and the ore averages 41.5 to 43.5 per cent Cr_2O_3, the average mine grade being 42 per cent. The Nos. 1 and 2 mines are situated about 3,500 feet apart and are working the same seams which are apparently continuous all the way between them, so that millions of tons of ore are available above the adit level. Some 63,000 tons of ore are actually developed and ready for stoping, and another 70,000 tons are fully assured by the development that has been done. In addition to this, some thousands of tons of surface ore are to be had on the surface, and 6,900 tons of ore stacked ready for loading at Steelport Station. The cost of delivering ore and mining (to Steelport Station) including royalty and administrative expenses was 11s. 3d. ($2.73), and the ore is worth 19s. 11d. ($4.84) per ton delivered on rail, which means a profit of 8s. 8d. ($2.11) for surface quarried ore. Underground mining adds 2s. 2d. per long ton, reducing the profit on this ore to 6s. 6d. ($1.47).
>
> The Winterveld No. 424 is situated on the Steelport River immediately north of Steelport Station. This farm has developed into a very important producer of the medium-grade ores. The portion of the farm containing chromite deposits is held under mineral lease from the Transvaal Consolidated Land & Exploration Co. (Ltd.), the royalty payable during the first three months being 1s. 9d. ($0.42) and 2s. ($0.48) thereafter. The chromite outcrops on the eastern slopes of a pyroxinite range of hills where three seams have been located. The lowest seam, No. 1, is the most important, ranging up to 6 feet in thickness, and is generally overlain at a distance of 2 to 4 feet by a thin upper seam averaging about 6 inches in thickness. The chromite of both seams is fairly high grade, averaging about 44 per cent Cr_2O_3 and up to 47 per cent. No difficulty is anticipated in

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[29] South African Mining and Engineering Journal, vol. 40, pt. 1, July 27, 1929, pp. 623–624.

maintaining from the Winterveld a production of 2,000 tons of 44 per cent ore a month. Using motor and lorry transport the surface residual ore, of which there is a considerable quantity, can be delivered on rail at Steelport Station at a cost, including commission, royalty, and administrative expense of 11s. 6d. ($2.79) on an ore averaging 22s. 3d. ($5.41) in value per long ton. The cost of adit mining is about 15s. 3d. ($3.71), cutting the profit on this sort of work to 7s. ($1.70). Lumpy hard ore is more valuable but costs more to mine, yielding about the same profit as the softer residual ore.

The Doornbosch No. 425 adjoins the Winterveld on the north and was leased from the same company under the same conditions. The main Winterveld seam has been disclosed at Doornbosch and will be prospected shortly.

The Mooihoek No. 147 is 12 miles north of the Steelport River, but the mine there is not being worked at present although what is apparently the Winterveld No. 1 seam is present.

The Rustenburg properties of the Chrome Corporation (South Africa) (Ltd.) include the farms Boekenhoutfontein No. 336, Bultfontein No. 354, Boschhoek No. 286, and Boschkoppie No. 685, all of which are held under mineral lease. The first-named is the best of this group. The property has been opened up along the Rustenburg-Boschhoek railway, and the company has its own siding. The mine is on one persistent seam, averaging 2 feet 6 inches in thickness, which has been opened up at intervals along a strike distance of 3,250 feet. The ore averages 42.5 per cent Cr_2O_3. The underground workings have attained an inclined depth of as much as 450 feet. It is now proposed that a steam shovel be installed to strip the overburden to the first level, a depth of 26 feet. This will expose the chromite seam to an inclined depth of 150 feet and the ore will be loaded by steam shovel. The mine is being equipped for the mining of 3,000 tons a month. It is assumed that half the ore will be minable by underground methods and the other half by open-cut methods.

The following summary[30] gives the general character of South African chromites:

> In the first place, it may be mentioned that the Bushveld occurrences of chromite are different from most other occurrences known. While chromite is usually found in lenticular form in serpentine and the lenses are irregular in size and in the way they are distributed through the serpentine, the Bushveld ore bodies are certainly of a lenticular character but the lenses are so elongated that they form something like a continuous band or seam resembling closely a bedded deposit. There is abundant evidence to show the magmatic origin of the chromite, but a geological section through the chromite-bearing series of rocks shows that, in the process of cooling of the molten magma, the different rock constituents of the magma became segregated into distinctive layers and produced the bedded appearance that they show to-day. The chromite bands or zones occur in the norite group of rocks, and besides the bands consisting of massive chromite the adjacent rocks often contain chromite finely disseminated through them.
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> The Bushveld chromites have been known for a good many years, but exploitation of them commenced about six years ago. So far they are mined only in two districts, one being the Lydenburg district, in the eastern part of the Bushveld, and the other the Rustenburg district, in the western part. Most of the chromite bands stretch over a length of hundreds of meters, or even kilometers, without interruption, although faulting is not infrequent, which may cause considerable displacement of the chromite zones. The thickness of the chromite bands varies from a few centimeters to over 4 meters. Usually there are two or more chromite horizons; in the Lydenburg district there are two and in places three. In the Rustenburg district there are three chromite bands, one under the other, being exploited. The chromite bands are separated by parallel bands of bronze norite or anorthosite or feldspar bronzite, practically free from chromite. In the chromite zones also there are thin partings of some other rock. The chromite shows a peculiar spotted appearance; in the ground mass of the granular black chromite are rounded pieces of bright bronzite and plagioclase. The chromite-bearing bronzite and norite are bright to dark green in color, spotted with black, while the plagioclase is almost snow-white. A section of the rock, therefore, presents a peculiar colored appearance.
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> The chromite is mined, partly by open working and partly from underground, in which case pillars must be left standing to support the roof. In the Lydenburg

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[30] Mining Journal, London, vol. 169, No. 4940, Apr. 26, 1930, p. 345.

district the chromite under exploration has a thickness of about 1.20 meters, although in places, as at Grootboom, it is 3.60 meters thick. In the Rustenburg district the chromite has less thickness but has an average Cr_2O_3 value of about 42.5 per cent, which compares with values of 41.5 to 47 per cent in the Lydenburg area. The transport of chromite to the nearest railway station is rather expensive, but there is said to be prospects of an early extension of railway communication to the chromite mines.

Total reserves of chromite in Transvaal are said to be great, probably amounting to several million tons. Some difficulty has been encountered in marketing Transvaal ores because of their high iron content, but it is believed that with proper educational programs this prejudice can be removed.

OCEANIA

NEW CALEDONIA

During 1929 exports[31] from New Caledonia amounted to 59,147 metric tons as compared with 56,698 tons in 1928. The exports for 1929 were distributed as follows:

	Metric tons		Metric tons
United States	26, 219	Great Britain	1, 219
Netherlands	20, 992	Australia	326
France	8, 166		
Belgium	2, 225		59, 147

The active producers[32] in the past few years include the following:

1. Société La Tiébaghi, working the Tiébaghi mine at Pagoumène.
2. The Société Chimique du Chrome, exploiting two mines—Fantouche and Alpha at Pagoumène.
3. The Société Caledonia, exploiting a group of mines at Coulée and at Plaine des Lacs.
4. M. Talon, operating a mine at Koumac.
5. M. Vernier, working the Alice-Louise mine in the Bay of N'Go.

Economic conditions in New Caledonia have been summarized as follows:[33]

> The chrome interests of New Caledonia claim that the tax of 10 per cent ad valorem amounting to 35 francs per ton as compared with 3 francs in Rhodesia is too heavy. Freight rates are high to the world's markets. Taxes in New Caledonia are frequently changed creating uncertainty in chrome mining centers. It is asserted that New Caledonian chrome ore can not regain its place in the world's market without aid from the local government. The mining interests call upon the administration to follow Rhodesia and British India in adopting stable mining legislation, refraining from exorbitant taxes, and developing means of transport in order that New Caledonia may extend mining operations and lower the costs of production. Competition between producers is more keen in the world's markets and New Caledonian producers are urged to prepare for the struggle.

The reserves in New Caledonia are approximately 1,500, 000 tons of 50 per cent plus ore, two-thirds of which is said to be in the Tiébaghi mine and the larger part of the remainder in the Fantouche and Alpha mines. The total production to date has been about 1,347,000 tons of ore averaging well above 50 per cent of Cr_2O_3.

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[31] Mining Journal, London, vol. 169, No. 4045, May 31, 1930, p. 441.

[32] Foreign Trade Notes. No. 287, Apr. 22, 1930, p. 7.

[33] Roberts, Quincy F., General Report of New Caledonia: Consular Rept. 329288, Jan. 30, 1930, Suva, Fiji Islands, pp. 80-81.

LEAD [1]

By Elmer W. Pehrson [2]

GENERAL SUMMARY

Salient figures of the lead industry in the United States, 1928 and 1929

	1928	1929
Production of refined primary lead:		
From domestic ores .... short tons..	626,202	672,498
From foreign ores and base bullion .... do....	154,869	102,135
	781,071	774,633
Recovery of secondary lead:		
As pig lead .... do....	138,000	138,500
In alloys .... do....	170,600	172,500
	308,600	311,000
Total production of pig lead (primary and secondary) .... do....	919,071	913,133
Imports (general):		
Lead in base bullion .... do....	128,468	83,071
Lead in ore .... do....	25,915	31,331
Exports:		
Refined pig lead from domestic ores .... do....	14,202	19,258
Refined pig lead from foreign materials .... do....	102,067	53,993
Apparent consumption of refined primary lead .... do....	657,565	692,765
Estimated consumption of primary and secondary lead .... do....	930,600	945,200
Prices per pound of refined lead at New York:		
Highest monthly average .... cents..	6.50	7.50
Lowest monthly average .... do....	6.02	6.25
Average for year .... do....	6.31	6.83
Quotation at end of year .... do....	6.50	6.25
Mine production of recoverable lead .... short tons..	[1] 627,153	[1] 647,995
Southeastern Missouri district .... per cent of total..	31	30
Utah .... do....	23	23
Coeur d'Alene region .... do....	22	22
Joplin (tri-State) region .... do....	11	11
All other .... do....	13	14
World smelter production of lead .... short tons..	1,852,000	1,971,000
United States .... per cent of total..	35	36
Mexico .... do....	13	13
Australia .... do....	9	10
Spain .... do....	8	8
Canada .... do....	8	8
All other .... do....	27	25

[1] Exclusive of the output from Virginia, figures for which the Bureau of Mines is not at liberty to publish.

Conditions in the lead industry were generally satisfactory throughout most of 1929. Domestic production and prices were considerably above the 1928 averages. The production of refined primary lead from domestic ores was 7 per cent more than that in 1928, but owing to decreased imports of Mexican base bullion the production of refined lead from foreign ores and base bullion decreased 34 per cent so that the total primary lead output from all sources was about 1 per cent less than that in 1928. Production in the United States was stimulated in March and April by the rapid increase in price resulting from the threatened curtailment of supply by the revolution in Mexico. This increase in production, together with a sharp falling off in domestic deliveries in April, May, and June, caused a sharp increase in stock, which reacted unfavorably on prices. From April to August production and price had declined steadily, whereas stocks had increased steadily, but by October consumption and production had returned to the March level, prices had recovered somewhat, and stocks were down. This rally, however, was terminated by the collapse of the stock market, and in November and December production, consumption, and prices declined sharply.

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[1] Work on manuscript completed November, 1930.

[2] The statistics in this report were prepared (unless otherwise indicated) by H. M. Meyer, and the data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

The New York quotation for lead increased steadily from 6.65 cents on January 2 to a high for the year of 7.80 cents during the latter part of March. Thereafter it declined steadily to an average of 6.75 cents in August. In October the average had increased to 6.87 cents, but in November and December there were sharp declines and on December 31 the quotation was 6.25 cents per pound. The average for the year was 6.83 cents, as compared to 6.31 cents in 1928.

The recovery of secondary lead in pig lead and alloys in 1929 again broke all previous records; it was equivalent to 46 per cent of the primary lead produced from domestic ores.

The total consumption of lead in the United States in 1929, as estimated by the American Bureau of Metal Statistics, surpassed all previous records, amounting to 945,200 tons, or an increase of 2 per cent over 1928 and 12 per cent over 1927. Storage batteries ranked first among the consumers of lead in 1929, taking 22.2 per cent of the total; cable covering was second, with 21.8 per cent; white lead third, with 12.5 per cent; and building fourth, with 10.2 per cent. There were decreases of 5 and 4 per cent, respectively, in the quantities of lead used in storage batteries and in white lead but an increase of 14 per cent in that used for cable covering.

Mine production of lead showed a 3 per cent gain in 1929. This rate of increase was fairly general for all areas, production in the Western States having increased 4 per cent and that in the Mississippi Valley States 3 per cent. Utah, Idaho, New Mexico, and Missouri showed the largest tonnage increases, while Colorado was the only State among the 10 largest producers to show a decrease.

General imports of lead in base bullion decreased 35 per cent as a result of a 47 per cent decrease in shipments from Mexico. Imports from Peru increased 130 per cent. Receipts of lead in ore and matte increased 21 per cent owing to increased shipments from Mexico. Exports of refined pig lead declined from 116,269 tons in 1928 to 73,251 tons in 1929 as a result of the decreased shipments of base bullion from Mexico which is refined in the United States under bond and exported from warehouse.

The Lead Industries Association, an organization of American producers and consumers of lead, expanded its statistical service during the year to include periodic reports on sales of domestic lead, manufacturer's stocks of pig lead, and the production, sales, and stocks of antimonial lead, mixed metals, white lead, red lead, litharge, sublimed lead, and orange mineral. It also distributed the monthly reports on production, shipments, and stocks of pig lead compiled by the Lead Producers Reporting Association of England.

World smelter production of lead in 1929 amounted to 1,971,000 short tons, an increase of 6 per cent over 1928. Production outside the United States increased 6 per cent, and the output of all but two of the 13 countries that produced 1 per cent or more of the world's lead was greater in 1929 than in 1928. The United States, Australia, Spain, Germany, Mexico, Russia, and Peru showed the largest tonnage increases.

The London price of lead in 1929 averaged £23.246 per long ton, or 5.04 cents per pound; this is 10 per cent above the 1928 average while the 1929 New York quotation is 8 per cent above the 1928 average.

The European lead cartel was reported to have consummated a working agreement between leading Mexican, Canadian, Australian, Indian, and continental producers. No announcement as to price fixing or production curtailment has been noted in the public press, so it is presumed that the cartel was engaged chiefly in the compilation of statistics. Producers of lead in Mexico, Canada, India (Burma), and Australia cooperated in selling their product through a central London agency.

Development during 1929 at Mount Isa, in Queensland, and Buchans, in Newfoundland, resulted in greatly increased ore reserves. Among the new deposits that appear to be promising future sources of lead are the Lake George mine in New South Wales, which is said to have a possible reserve of 5,000,000 tons of ore containing 7.5 per cent of lead in addition to other metals, and the large low-grade deposit at Lawn Hills, Queensland. Several companies were actively developing lead deposits in Yugoslavia in 1929. The most promising to date is the Stantrg mine, which has a reserve of nearly 2,000,000 tons of ore containing 11.5 per cent of lead, 10.5 per cent of zinc, and 3 ounces of silver. In Canada the reserves of the Sullivan mine, British Columbia, and the Mayo district, Yukon, were greatly increased by development work in 1929. Extensive deposits of lead-zinc ores were reported in the Great Slave Lake area of Northwest Territories. No extensive discovery of lead ore was reported in the United States in 1929.

PRODUCTION

GENERAL

Pig lead produced in the United States for domestic market and export is derived from three main sources—domestic ore, foreign ore and base bullion, and secondary materials. The following table shows the quantity of pig lead produced from each of these sources from 1920 to 1929.

Pig lead produced in the United States, 1920–1929, in short tons

Year	From domestic ores and base bullion	From foreign ores and base bullion	From secondary materials	Total
1920	476, 849	52, 808	56, 350	586, 007
1921	398, 222	50, 367	46, 370	494, 959
1922	468, 746	63, 916	75, 480	608, 142
1923	543, 841	74, 481	96, 430	714, 752
1924	566, 407	124, 086	90, 400	780, 893
1925	654, 921	112, 048	112, 420	879, 389
1926	680, 685	118, 256	125, 000	923, 941
1927	668, 320	128, 210	119, 000	915, 530
1928	626, 202	154, 869	138, 000	919, 071
1929	672, 498	102, 135	138, 500	913, 133

The total production of pig lead in the United States in 1929 decreased 5,938 tons, or less than 1 per cent. Production from domestic ores and base bullion increased 7 per cent, whereas that from foreign ore and base bullion decreased 34 per cent. Production of pig lead from secondary materials increased slightly.

PRIMARY LEAD

REFINERY PRODUCTION

Pig lead is classified by the Bureau of Mines as primary or secondary, according to whether it is derived directly from the smelting of ores and from base bullion or is reclaimed from industrial lead scrap. Some plants that ordinarily smelt ore frequently add lead scrap to the charge, so that the resulting product is an inseparable mixture of lead from both sources and is all marketed as refined pig lead. Nevertheless, the smelter calculates the quantity of secondary lead so produced, thus enabling the Bureau of Mines to obtain a consecutive record of the amount of primary lead being supplied to the trade each year.

Primary lead may be produced from domestic ore or foreign ore and from base bullion. The smelting of lead-bearing ores from the Western States yields an impure pig lead (base bullion) that contains valuable amounts of silver and gold, in addition to objectionable impurities such as copper, arsenic, and antimony. This base bullion is given further treatment for the removal of the impurities and finally emerges for the market as refined pig lead. The smelting of lead-bearing ores from the Mississippi Valley and Southern States yields soft lead pure enough for marketing, but some of it is desilverized and is designated in this report as desilverized soft lead. Foreign ore is first smelted into base bullion and then refined for market. Foreign base bullion imported into the United States is also refined before marketing. All of these products for market are referred to as refined lead. The following table gives a summary of the refined primary lead produced in the United States from 1720 to 1929.

Refined primary lead produced in the United States, 1720–1929

Year	Short tons							Value	
	Desilverized lead [1] [2]	Desilverized soft lead	Soft lead [2]	Total production [1]	From domestic ores and base bullion	From foreign ores	From foreign base bullion	Average per pound	Total
1720–1912	7,176,497	326,991	2,929,180	10,432,668	8,545,383	1,887,285		--------	$924,600,000
1913	301,160	29,433	131,867	462,460	411,878	13,223	37,359	$0.044	40,696,000
1914	340,397	43,506	158,219	542,122	512,794	7,639	21,689	.039	42,286,000
1915	344,593	44,001	161,461	550,055	507,026	9,581	33,448	.047	51,705,000
1916	335,375	68,244	167,515	571,134	552,228	6,085	12,821	.069	78,817,000
1917	365,998	56,268	188,503	610,769	548,450	15,872	46,447	.086	105,052,000
1918	382,314	47,418	210,463	640,195	539,905	15,334	84,956	.071	90,908,000
1919	266,538	67,938	147,744	482,220	424,433	7,656	50,131	.053	51,115,000
1920	273,135	66,668	189,854	529,657	476,849	8,414	44,394	.080	84,745,000
1921	238,329	52,747	157,513	448,589	398,222	7,120	43,247	.045	40,373,000
1922	249,107	74,305	209,250	532,662	468,746	13,898	50,018	.055	58,593,000
1923	366,241	61,332	190,749	618,322	543,841	24,288	50,193	.070	86,565,000
1924	423,429	63,449	203,615	690,493	566,407	46,385	77,701	.080	110,479,000
1925	457,477	48,932	260,560	766,969	654,921	47,024	65,024	.087	133,453,000
1926	484,669	55,707	258,565	798,941	680,685	48,210	70,046	.080	127,831,000
1927	507,099	55,487	233,944	796,530	668,320	32,369	95,841	.063	100,363,000
1928	506,603	49,465	225,003	781,071	626,202	26,632	128,237	.058	90,604,000
1929	483,622	55,666	235,345	774,633	672,498	29,675	72,460	.063	97,604,000
	13,502,583	1,267,557	6,259,350	21,029,490	17,798,788	3,230,702		--------	2,315,789,000

[1] The lead content of antimonial lead is excluded (see p. 238). [2] Desilverized soft lead is excluded.

The total production of refined primary lead in the United States in 1929 was nearly 1 per cent less than that in 1928 and only 3 per cent less than the 1926 output, the maximum annual output to date. The total value of the 1929 output was 8 per cent greater than that of 1928, due to an increase of one-half cent per pound in the average price of lead, but amounted to only 73 per cent of the 1925 value, the peak annual value up to the end of 1929.

Two outstanding features in the production of primary lead in the United States in 1929 were the decreased output from foreign base bullion and the increased production from domestic ores. The production of refined lead from foreign base bullion dropped from 128,237 tons in 1928 to 72,460 tons in 1929, a decrease of 43 per cent. Refined lead produced from foreign ores and base bullion amounted to 13 per cent of the total primary lead output in 1929, as compared to 20 per cent in 1928 and 16 per cent in 1927. The production of refined lead from domestic ores in 1929 was 46,296 tons, or 7 per cent greater than in 1928, and was the second largest annual output ever recorded. The following table shows the quantity and value of refined lead produced in the United States from domestic ores from 1920 to 1929:

Refined lead produced in the United States from domestic ores, 1920–1929

Year	Short tons	Value	Year	Short tons	Value
1920	476, 849	$76, 296, 000	1925	654, 921	$113, 956, 000
1921	398, 222	35, 840, 000	1926	680, 685	108, 910, 000
1922	468, 746	51, 562, 000	1927	668, 320	84, 208, 000
1923	543, 841	76, 138, 000	1928	626, 202	72, 639, 000
1924	566, 407	90, 625, 000	1929	672, 498	84, 735, 000

GEOGRAPHICAL SOURCE OF LEAD RAW MATERIALS SMELTED OR REFINED IN THE UNITED STATES

The following table shows the source of the ore and foreign base bullion from which refined lead was produced in the United States from 1920 to 1929. A large part of the base bullion produced in the Western States is shipped to the Mississippi Valley and Eastern States for refining. In reporting the production of lead by sources most of the refiners make the distribution on the basis of base bullion, so that the total lead given in this table as from domestic ore includes both base bullion and refined lead and thus contains a large part of the antimonial lead produced from domestic ores. The domestic total given here for 1929 exceeds the total production of refined lead from domestic ores, as shown in the preceding table by 13,494 tons. The production of antimonial lead from domestic ores in 1929 amounted to 17,062 tons.

Primary lead smelted or refined in the United States, 1920–1929, by sources, in short tons

Source of ore	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Domestic ore:										
Alaska	591	773	324	400	582	699	1,018	1,010	962	1,266
Arizona	5,987	3,313	7,218	8,828	9,372	10,281	10,646	7,918	8,144	8,153
California	2,260	614	3,018	5,168	2,305	4,148	4,044	1,232	637	1,459
Colorado	17,752	12,104	11,108	23,885	25,491	31,855	37,553	37,040	28,683	23,675
Idaho	117,191	99,707	91,487	127,797	123,709	123,363	132,564	150,618	141,748	147,595
Illinois [1]	948	271	750	1,286	1,089	474	357	222	398	777
Kansas [1]	8,421	10,939	10,900	20,207	12,895	15,001	20,884	[2] 25,463	[2] 27,014	[2] 26,104
Kentucky [1]	114	41	73	66	201	96	27	139	268	303
Missouri [1]	171,999	151,028	202,245	169,323	191,501	208,547	218,083	210,366	192,789	211,345
Montana	13,231	11,565	14,551	18,345	21,226	22,008	26,350	23,041	20,470	26,795
Nevada	8,650	3,553	4,264	8,044	8,070	10,978	11,379	8,680	6,823	13,256
New Mexico	1,123	384	1,230	1,638	2,263	3,782	4,383	8,377	8,469	12,249
Oklahoma [1]	68,494	46,902	67,436	59,602	56,017	78,487	70,004	[2] 47,857	[2] 46,692	[2] 45,653
Oregon	--------	--------	37	47	--------	6	5	2	7	15
South Dakota	6	2	2	--------	2	2	1	79	37	--------
Tennessee [1]	2,705	--------	751	1,020	985	436	770	19	--------	--------
Texas	1	1	5	40	27	31	102	275	437	559
Utah	64,006	51,872	63,130	104,678	119,318	166,844	151,127	155,199	151,724	157,085
Virginia [1]	--------	--------	--------	--------	1,582	2,179	1,714	2,214	4,944	(3)
Washington	2,460	325	478	2,008	2,057	2,802	2,262	442	537	447
Wisconsin [1]	3,841	1,079	1,323	601	1,973	2,889	2,052	2,067	1,812	1,729
Undistributed	201	101	75	691	15	2	--------	--------	--------	5,624
Zinc residues	4,366	713	1,284	362	1,320	1,541	505	1,905	102	1,903
	494,347	395,287	481,689	554,036	582,000	686,451	695,830	684,165	642,697	685,992
Foreign ore:										
Africa	1,171	--------	--------	99	6	--------	6	12	--------	--------
Australia	450	--------	--------	--------	--------	--------	--------	2	2	5
Canada	1,186	2,877	3,604	3,632	4,633	10,676	5,385	4,138	10,123	9,499
Central America	22	6	14	18	30	6	--------	18	3	--------
Europe	19	17	519	139	328	470	233	19	67	28
Mexico	2,729	1,912	7,260	18,867	33,328	31,107	32,693	22,844	14,839	16,807
South America	2,747	2,235	2,458	1,461	7,663	4,496	9,893	5,506	1,568	3,285
Other foreign	90	73	43	72	397	269	--------	--------	30	51
Foreign base bullion:										
Canada	1,919	1,599	2,900	--------	--------	--------	--------	--------	--------	--------
Mexico	42,421	41,648	47,118	50,193	77,701	65,024	70,046	95,841	117,193	51,295
South America	54	--------	--------	--------	--------	--------	--------	--------	11,044	21,165
	52,808	50,367	63,916	74,481	124,086	112,048	118,256	128,380	154,869	102,135
Grand total	547,155	445,654	545,605	628,517	706,086	798,499	814,086	812,545	797,566	788,127

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[1] The lead produced by these States is nonargentiferous or soft lead. A small quantity of the lead produced from Colorado and New Mexico ores is also nonargentiferous.

[2] The smelter output of lead in Kansas and Oklahoma is separated on the basis of mine output as the Bureau of Mines has been unable to obtain an accurate separation of smelter output.

[3] Included under "Undistributed." Bureau of Mines not at liberty to publish figures.

The table shows that in 1929, 87 per cent of the primary lead smelted or refined in the United States was derived from domestic ores, 4 per cent from the smelting of foreign ores, and 9 per cent from the refining of foreign base bullion. There were substantial increases in lead production in 1929 in most of the important lead-producing States. Decreased production was recorded for Colorado, Kansas, Oklahoma, Washington, and Wisconsin. Foreign ore smelted in the United States in 1929 came largely from Mexico, Canada, and South America (chiefly Chile). Refined lead produced in the United States from Mexican base bullion decreased 56 per cent in 1929 owing to the completion of new refineries in Mexico which treated a larger part of the Mexican production of base bullion. There was an increase of 92 per cent in the production of refined lead from South American (chiefly Peruvian) base bullion.

SPECIFICATIONS FOR PIG LEAD

The American Society for Testing Materials classifies pig lead in three grades—corroding, chemical, and common. The requirements as to chemical composition are shown in the following table.

Allowable chemical composition of the various grades of pig lead, as specified by the American Society for Testing Materials

	Corroding lead,[1] not over—	Chemical lead [2]	Common lead	
			Desilverized lead, not over—	Soft Missouri lead, not over—
	Per cent	*Per cent*	*Per cent*	*Per cent*
Silver	0.0015	0.005–0.015	0.002	0.002
Copper	.0015	.04– .08	.0025	.040
Copper and silver together	.0025	(3)	(3)	(3)
Arsenic	.0015	(3)	.015	.015
Antimony and tin together	.0095	(3)		
Zinc	.0015	(3)	.002	.002
Iron	.002	(3)	.002	.005
Bismuth	.05	(4)	.25	.005
Lead, by difference	99.9300	(5)	99.7265	99.931

[1] The maximum limits for bismuth, copper, and silver have been given, but it is not expected that any delivery will contain the maximum of all three.
[2] Chemical lead is a designation that has been used for many years in the trade to describe the undesilverized lead produced from southeastern Missouri ores.
[3] Not given.
[4] Less than 0.005 per cent.
[5] Not specified.

SOFT LEAD

A large part (43 per cent in 1929) of the lead produced in the United States from domestic ores is derived from the nonargentiferous lead ores of the Mississippi River basin. The two principal ore-producing areas are the southeastern Missouri district and the tri-State district (Joplin) at the junction of Missouri, Kansas, and Oklahoma. The former district produced about 66 per cent and the latter 25 per cent of the total soft lead in ore mined in 1929.

Eighty-one per cent of the soft pig lead produced in 1929 was marketed without desilverizing, and 19 per cent was desilverized. The former, which is known in the trade as chemical lead, contains 1 to 4 ounces of silver to the ton and 0.04 to 0.08 per cent copper; it is used chiefly in the manufacture of cable, pipe, and sheets. Desilverized soft lead is used largely in the manufacture of white lead, where a very pure product is required.

A substantial quantity of high-grade lead concentrates from the Mississippi Valley is used each year in the manufacture of lead pigments, principally basic lead sulphate (white sublimed lead) and leaded zinc oxide. In 1929 nearly 9,500 tons of soft lead was recovered in this manner.

The following table summarizes the production of soft lead from 1922 to 1929:

Soft lead produced in the United States from domestic ores, 1922–1929, in short tons

Year	Soft pig lead			Soft lead recovered in pigments	Total soft lead	Total domestic lead [1]	Soft lead percentage of domestic lead
	Undesilverized	Desilverized	Total				
1922	209,250	74,305	283,555	13,892	297,447	488,448	61
1923	190,749	61,332	252,081	13,612	265,693	567,247	47
1924	203,615	63,449	267,064	15,338	282,402	593,486	48
1925	260,560	48,932	309,492	17,547	327,039	684,968	48
1926	258,565	55,707	314,272	13,685	327,957	710,990	46
1927	233,944	55,487	289,431	13,136	302,567	695,500	44
1928	225,003	49,465	274,468	10,465	284,933	652,492	44
1929	235,345	55,666	291,011	9,429	300,440	696.678	43

[1] Includes domestic refined lead, domestic lead in antimonial lead, and domestic lead in pigments.

ANTIMONIAL LEAD

Antimonial lead is an important by-product of the refining of base bullion. In 1929, 25,669 tons of primary antimonial lead was produced, which contained 22,617 tons of lead, a decrease of 22 per cent from the 1928 output of antimonial lead and equivalent to 5.3 per cent of the total refined lead produced from base bullion.

The decreased importation of base bullion from Mexico had a marked effect on the production of primary antimonial lead. In 1928 more than 15,000 tons was produced from the smelting and refining of foreign ores and base bullion, whereas in 1929 only 8,600 tons was derived from the same source. Foreign ores also yield a higher percentage of antimonial lead. The production of antimonial lead from foreign ores was equivalent to 9.8 per cent of the refined lead produced from those ores in 1928 and to 8.4 per cent in 1929, while the yield from domestic ores was 5.1 and 4.5 per cent, respectively.

The principal uses of antimonial lead are in the manufacture of storage batteries, bearing metal, and type metal. The consumption of antimonial lead in storage batteries decreased about 3 per cent in 1929. The following table shows the production of primary antimonial lead from 1920 to 1929:

By-product primary antimonial lead produced in the United States, 1920–1929

Year	Total lead refined from base bullion (short tons)	By-product antimonial lead (percentage of total)	Antimonial lead						
			From domestic ore (short tons)	From foreign ore (short tons)	Total				
					Short tons	Value	Antimony content		Lead content by difference (short tons)
							Short tons	Percentage	
1920	273,135	4.6	9,604	2,931	12,535	$1,963,255	2,033	16.2	10,502
1921	238,329	4.2	7,881	2,183	10,064	870,059	1,589	15.8	8,475
1922	249,107	3.2	7,068	1,007	8,075	844,993	1,441	17.8	6,634
1923	366,241	3.9	11,635	2,555	14,190	1,950,370	2,170	15.3	12,020
1924	423,429	4.9	13,593	7,194	20,787	3,376,713	2,763	13.3	18,024
1925	457,477	4.3	14,472	5,195	19,667	3,785,547	2,624	13.3	17,043
1926	484,669	4.6	18,909	3,615	22,524	3,916,714	2,693	12.0	19,831
1927	507,099	4.8	16,040	8,307	24,347	3,277,043	2,736	11.2	21,611
1928	506,603	6.5	17,930	15,128	33,058	3,978,318	3,432	10.4	29,626
1929	483,622	5.3	17,062	8,607	25,669	3.267,095	3,052	11.9	22,617
Average		4.8						12.9	

SECONDARY LEAD

Much of the lead consumed in the United States is used in the manufacture of articles from which there is a large return of secondary metal. This is particularly true of the storage-battery industry, which is the leading single consumer of lead and in which there is a large and rapid return of secondary metal. This industry is responsible for much of the increase in the ratio of secondary lead production to domestic primary lead production. In 1914 the secondary output was equivalent to only 12 per cent of the primary output from domestic ores; in 1929 the ratio was 46 per cent, a decrease from 49 per cent in 1928. Other important lead-consuming industries in which there is a large return of secondary metal include cable manufacture, building, bearing-metal manufacture, and type-metal manufacture.

Fifty-five per cent of the secondary lead output in 1929 was recovered in the form of alloys, principally alloys of lead, tin, and antimony, and 45 per cent was recovered as pig lead.

The following tables show the recovery of secondary lead and its ratio to the refined primary lead produced in the United States from domestic ores. Further details of the secondary lead industry may be found in the Mineral Resources chapter on secondary metals.

Secondary lead recovered in the United States, 1922–1929, in short tons

Year	Pig lead	Lead in alloys	Total recovered lead	Value
1922	75, 480	84, 080	159, 560	$17, 552, 000
1923	96, 430	98, 060	194, 490	27, 229, 000
1924	90, 400	114, 100	204, 500	32, 720, 000
1925	112, 420	114, 460	226, 880	39, 477, 000
1926	125, 000	152, 300	277, 300	44, 368, 000
1927	119, 000	157, 000	276, 000	34, 776, 000
1928	138, 000	170, 600	308, 600	35, 798, 000
1929	138, 500	172, 500	311, 000	39, 186, 000

Ratio of secondary lead recovered to refined primary lead produced in the United States from domestic ores, 1913–1929

Year	Refined primary lead		Secondary lead	
	Short tons	Average price per pound (cents)	Short tons	Ratio to refined primary lead (per cent)
1913	411, 878	4. 4	72, 834	18
1914	512, 794	3. 9	61, 062	12
1915	507, 026	4. 7	78, 900	16
1916	552, 228	6. 9	96, 300	17
1917	548, 450	8. 6	93, 500	17
1918	539, 905	7. 1	97, 100	18
1919	424, 433	5. 3	122, 100	29
1920	476, 849	8. 0	124, 650	26
1921	398, 222	4. 5	103, 780	26
1922	468, 746	5. 5	159, 560	34
1923	543, 841	7. 0	194, 490	36
1924	566, 407	8. 0	204, 500	36
1925	654, 921	8. 7	226, 880	35
1926	680, 685	8. 0	277, 300	41
1927	668, 320	6. 3	276, 000	41
1928	626, 202	5. 8	308, 600	49
1929	672, 498	6. 3	311, 000	46

PIGMENTS

Lead pigments manufactured in 1929 contained 260,513 tons of lead derived from the sources shown in the following table. Refined pig lead is used in the manufacture of white lead, litharge, red lead, sublimed lead, and orange mineral. In 1929 about 249,000 tons of the lead contained in lead pigments was derived from refined pig lead; white lead accounting for 48.3 per cent, litharge 33.2 per cent, red lead 15.8 per cent, and sublimed lead and orange mineral 2.7 per cent. Sublimed lead and leaded zinc oxide are the principal pigments in which the lead content is derived from ores.

Further details of the production and value of lead pigments in the United States are given in the Mineral Resources chapter on lead and zinc pigments and salts.

Lead in pigments,[1] 1922–1929, by sources, in short tons

Year	Lead in pigments from—				
	Domestic ore	Foreign ore	Metal	Scrap	Total
1922	13,892	----------	241,096	111	255,099
1923	13,612	----------	236,541	----------	250,153
1924	15,338	545	250,930	----------	266,813
1925	17,547	----------	256,064	----------	273,611
1926	13,685	----------	240,902	1,029	255,616
1927	13,136	----------	242,713	1,246	257,095
1928	10,465	----------	242,914	654	254,033
1929	9,429	----------	248,657	2,427	260,513

[1] Includes also lead recovered in zinc oxide and leaded zinc oxide.

MINE PRODUCTION

BY STATES

The following table shows the mine production of recoverable lead by States from 1920 to 1929:

Mine production of recoverable lead, 1920–1929, by States, in short tons

State	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Alaska	875	759	377	410	631	789	778	1,008	1,019	1,315
Arizona	6,935	3,271	7,535	8,146	9,321	11,938	11,629	9,933	7,190	8,027
Arkansas	8	21	42	25	20	58	18	23	38	51
California	2,407	562	3,156	4,775	2,382	3,283	4,047	1,359	946	715
Colorado	23,315	9,830	11,739	22,849	23,779	31,483	34,494	33,386	26,751	24,445
Georgia	2	--------	4	--------	--------	--------	--------	--------	--------	--------
Idaho	118,565	99,235	97,917	121,178	124,475	126,521	136,490	151,019	145,323	148,695
Illinois	1,708	672	1,325	1,381	1,464	1,001	655	277	385	443
Kansas	16,452	18,679	23,271	17,598	18,560	22,775	28,463	27,497	25,276	26,596
Kentucky	120	69	92	53	175	152	58	139	39	287
Massachusetts	14	--------	--------	--------	(1)	--------	--------	--------	--------	--------
Missouri	161,812	180,085	178,412	169,743	189,929	211,566	207,012	198,760	195,393	198,469
Montana	14,846	10,183	14,884	17,973	19,738	18,765	21,153	17,949	16,880	19,607
Nevada	10,100	3,594	4,695	9,078	10,030	12,238	11,184	7,892	7,874	9,846
New Mexico	1,435	339	1,506	1,916	1,817	3,210	3,480	8,026	7,805	11,130
Oklahoma	64,086	41,552	62,856	66,904	71,358	79,946	69,704	51,680	43,687	46,513
Oregon	--------	--------	38	14	(2)	3	6	3	7	10
Pennsylvania	7	--------	--------	--------	--------	--------	--------	--------	--------	--------
South Dakota	6	2	--------	--------	--------	--------	--------	69	37	--------
Tennessee	1,880	--------	732	1,250	937	448	800	--------	--------	--------
Texas	--------	--------	4	13	--------	8	42	244	348	425
Utah	66,898	44,594	67,666	101,724	116,955	153,335	147,635	151,285	145,915	149,377
Virginia	--------	--------	--------	--------	1,275	2,229	2,450	2,393	(3)	(3)
Washington	2,749	72	691	1,453	1,968	2,814	2,273	478	542	508
Wisconsin	2,594	972	691	734	1,254	1,877	1,546	2,069	1,698	1,536
	496,814	414,491	477,633	547,217	596,068	684,439	683,917	665,489	[4] 627,153	[4] 647,995

[1] It is said that a few tons of lead ore was mined at the old Chipman mine in Massachusetts and was treated at a small smelter owned by the mine operators.

[2] 513 pounds.

[3] Bureau of Mines not at liberty to publish figures.

[4] Exclusive of the output from Virginia, figures for which the Bureau of Mines is not at liberty to publish.

BY DISTRICTS

The following table gives the lead production in the principal lead-producing districts.

Mine production of recoverable lead in the principal lead-producing districts of the United States, 1921–1929, in short tons

District	State	1921	1922	1923	1924	1925	1926	1927	1928	1929
Southeastern Missouri region.	Missouri	178, 735	176, 768	167, 458	187, 737	208, 915	203, 062	196, 251	194, 270	197, 435
Coeur d'Alene region.	Idaho	94, 543	91, 216	114, 426	118, 327	120. 856	128, 834	141, 948	139, 276	141, 558
Joplin region	Kansas, Missouri, Oklahoma.	61, 581	87, 771	86, 787	92, 110	105, 372	102, 117	81, 686	70, 086	74, 143
Bingham	Utah	12, 288	19, 348	25, 353	34, 786	54, 982	54, 997	55, 508	52, 375	49, 447
Tintic	do	18, 158	23, 646	38, 906	40, 674	45, 889	47, 108	45, 045	44, 096	44, 113
Park City region	do	8, 846	16, 129	26, 220	33, 346	40, 656	35, 910	41, 403	41, 427	42, 570
San Juan Mountains.	Colorado	5, 323	5, 332	13, 157	13, 148	17, 092	19, 237	21, 739	18, 555	17, 386
Rush Valley	Utah	607	586	1, 284	926	2, 465	5, 022	7, 346	7, 222	11, 751
Butte	Montana	6, 614	10, 070	12, 745	13, 648	12, 091	13, 678	12, 769	12, 330	8, 239
Barker	do	856	971	846	1, 272	1, 420	1, 387	412	264	6, 137
Willow Creek	New Mexico	-------	-------	-------	-------	-------	-------	4, 353	5, 193	5, 720
Leadville	Colorado	1, 762	2, 742	2, 804	4, 795	6, 931	9, 266	6, 781	5, 168	5, 172
Central	New Mexico	2	176	656	592	1, 182	1, 306	954	1, 180	3, 766
Pioche	Nevada	666	932	2, 697	2, 152	2, 806	2, 420	639	1, 167	2, 986
Banner	Arizona	10	2, 140	1, 731	160	49	7	13	490	2, 938
Jack Rabbit	Nevada	866	791	536	120	224	578	1, 266	2, 561	2, 430
Tybo	do	-------	-------	-------	1	3	1	-------	-------	1, 991
Dome	Idaho	24	-------	-------	276	602	246	1, 182	1, 074	1, 870
Upper Mississippi Valley.	Iowa, Northern Illinois, Wisconsin.	1, 506	1, 259	948	1, 639	2, 355	1, 819	2, 141	1, 706	1, 536
Warm Springs	Idaho	2, 374	1, 758	925	357	355	149	478	1, 307	1, 507
Cedar Plains	Montana	140	23	274	230	175	346	373	657	1, 177
Bisbee (Warren)	Arizona	2, 335	4, 187	4, 221	5, 719	6, 657	5, 729	5, 256	2, 917	1, 020
Pend d'Oreille	Idaho	1	238	304	67	113	481	1, 048	694	863
Vulture	Arizona	-------	3	-------	4	26	133	133	1, 291	777
Kentucky-Southern Illinois.	Kentucky-Illinois.	207	849	1, 220	1, 254	675	440	344	416	730
Aspen	Colorado	1, 198	1, 778	1, 486	455	1, 820	1, 632	1, 203	806	710
San Francisco	Utah	442	1, 118	1, 489	1, 069	1, 999	1, 325	420	199	691
Inyo County	California	523	3, 135	4, 744	2, 306	3, 098	3, 278	1, 081	872	670
Yellow Pine	Nevada	93	158	736	3, 855	2, 644	952	826	1, 105	535
Montana	Montana	749	775	912	1, 241	1, 427	2, 069	1, 866	1, 432	493
Magdalena	New Mexico	30	462	753	818	1, 217	700	819	496	481
Spruce Mountain	Nevada	458	237	261	508	647	1, 099	636	529	388
Eureka	do	388	251	673	888	2, 163	2, 784	1, 132	466	378
Summit County	Colorado	252	280	1, 946	1, 105	1, 707	1, 481	614	786	369
Bryant	Montana	83	158	968	1, 743	1, 150	730	398	195	344
Eagle County	Colorado	6	161	230	1, 145	2, 041	1, 305	2, 059	750	198
Texas	Idaho	971	2, 168	2, 417	2, 197	1, 714	2, 882	3, 895	1, 195	182
Big and Little Cottonwood.	Utah	2, 230	2, 754	3, 831	3, 128	2, 374	1, 597	1, 009	146	173
Northport	Washington	50	534	1, 062	1, 232	2, 218	1, 984	325	503	76
Troy	Montana	377	1, 528	1, 059	530	259	231	181	33	49
Ophir	Utah	480	2, 921	3, 443	1, 414	2, 945	217	157	101	25
Port Hill	Idaho	750	1, 440	2, 116	2, 317	1, 506	1, 597	468	414	-------
New Placers	New Mexico	-------	-------	-------	3	125	527	1, 100	48	-------
Mammoth	Nevada	3	5	2	21	331	365	1, 195	21	-------
Bell	do	-------	612	1, 160	-------	128	455	143	-------	-------
Embree	Tennessee	-------	732	1, 250	937	448	800	-------	-------	-------
Austinville [1]	Virginia	-------	-------	-------	1, 275	782	1, 582	2, 393	(2)	(2)
Boulder [1]	Idaho	-------	-------	-------	(2)	(2)	(2)	(2)	(2)	(2)
Oro Blanco [1]	Arizona	-------	-------	-------	1	4	-------	7	707	(2)

[1] Not listed according to rank.

[2] Bureau of Mines not at liberty to publish figures.

LEAD BALANCE SHEET OF THE UNITED STATES

Most of the lead ore mined in the United States is smelted, and its lead content emerges in marketable form as primary refined pig lead and antimonial lead. Some of the ore is used in the manufacture of pigments and some may be exported, but for several years the amount exported has been negligible. The total primary domestic lead in the various products in which it is produced for market is compared in the following table with the estimates of recoverable lead in the ore mined. The table begins with 1907, the first year for which the mine production of the entire country was determined. As the quantities compared were determined by independent canvasses of the producers and consumers of lead-bearing ore, the table gives a check on the accuracy of the figures.

Comparison of mine production of lead and primary domestic lead accounted for in lead products manufactured in the United States, 1907–1929, in short tons

Year	Mine production	Primary lead accounted for in—				Primary excess (+) or mine excess (−)
		Refined lead	Antimonial lead	Pigments made from ore	Total	
1907–1918	5,653,706	5,249,081	124,168	121,756	[1] 5,503,330	−150,376
1919	429,589	424,433	8,339	11,179	[2] 443,954	+14,365
1920	496,814	476,849	8,032	15,212	500,093	+3,279
1921	414,491	398,222	6,675	9,989	414,886	+395
1922	477,633	468,746	5,810	13,892	488,448	+10,815
1923	547,217	543,841	9,794	13,612	567,247	+20,030
1924	596,068	566,407	11,741	15,338	593,486	−2,582
1925	684,439	654,921	12,500	17,547	684,968	+529
1926	683,917	680,685	16,620	13,685	710,990	+27,073
1927	665,489	668,320	14,044	13,136	695,500	+30,011
1928	[3] 627,153	626,202	15,825	10,465	652,492	+25,339
1929	[3] 647,995	672,498	14,751	9,429	696.678	+48,683
1919–1929	6,270,805	6,181,124	124,131	143,484	6,448,742	+177,937
1907–1929	11,924,511	11,430,205	248,299	265,240	11,952,072	+27,561

[1] Includes 8,325 tons of lead produced from domestic ores smelted outside the country.
[2] Includes 3 tons of lead produced from domestic ores smelted outside the country.
[3] Exclusive of the output from Virginia, figures for which the Bureau of Mines is not at liberty to publish.

The table shows substantial discrepancies for individual years, probably due largely to variations in mine and smelter stocks of ore, but in none of the last 11 years has the discrepancy exceeded 7 per cent of the total lead produced. From 1907 to 1918, inclusive, mine production exceeded the primary lead accounted for in lead products by 150,000 tons, or less than 3 per cent. From 1919 to 1929 there was an excess of nearly 178,000 tons, or less than 3 per cent, in favor of the lead contained in the lead products. For the total period of 23 years, 1907 to 1929, the primary lead content of lead products exceeded mine production by only 27,561 tons, or about one-fifth of 1 per cent.

LEAD SMELTERS AND REFINERIES

A list of lead smelters and refineries in the United States, Canada, and Mexico follows.

UNITED STATES

Arizona: Douglas—Phelps Dodge Corporation. (Smelter.)
California: Selby—Selby plant, American Smelting & Refining Co. (Smelter and refinery.)
Colorado:
    Durango—Durango plant, American Smelting & Refining Co. (Smelter.)
    Leadville—Arkansas Valley plant, American Smelting & Refining Co. (Smelter.)
Idaho: Bradley—Bunker Hill & Sullivan smelter. (Smelter and refinery.)
Illinois:
    Collinsville—St. Louis Smelting & Refining Works of National Lead Co. (Smelter and refinery.)
    Federal—Federal plant, American Smelting & Refining Co. (Smelter.)
Indiana:
    East Chicago—International Lead Refining Co.[3] (Refinery only.)
    East Chicago—U. S. S. Lead Refinery (Inc.)[4] (Refinery only. Betts electrolytic process.)
Kansas: Galena—Galena plant, Eagle-Picher Lead Co. (Smelter.)
Missouri:
    Granby—American Zinc, Lead & Smelting Co.[5] (Smelter.)
    Herculaneum—St. Joseph Lead Co. (Smelter and refinery.)
    Joplin—Eagle-Picher Lead Co. (Smelter.)
Montana: East Helena—East Helena plant, American Smelting & Refining Co. (Smelter.)

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[3] Subsidiary of Anaconda Copper Mining Co.
[4] Subsidiary of the United States Smelting, Refining & Mining Co.
[5] Plant idle in 1929.

Nebraska: Omaha—Omaha plant, American Smelting & Refining Co. (Smelter and refinery.)

New Jersey:
- Newark—Balbach plant, U. S. Metals Refining Co. (Smelter and refinery.)
- Perth Amboy—Perth Amboy plant, American Smelting & Refining Co. (Smelter and refinery.)

Oklahoma: St. Louis—Ontario smelter, Eagle-Picher Lead Co. (Smelter.)

Pennsylvania: Carnegie—Pennsylvania Smelting Co.[5] (Smelter and refinery.)

Texas: El Paso—El Paso plant, American Smelting & Refining Co. (Smelter.)

Utah:
- International—International Smelting Co.[3] (Smelter.)
- Midvale—United States Smelting, Refining & Mining Co. (Smelter.)
- Murray—Murray plant, American Smelting & Refining Co. (Smelter.)

CANADA

British Columbia: Trail—Consolidated Mining & Smelting Co. of Canada (Ltd.). (Smelter and refinery. Betts electrolytic process.)

Ontario: Galetta—Kingdon Mining, Smelting & Manufacturing Co. (Ltd.). (Smelter.)

MEXICO

Chihuahua: Chihuahua—American Smelting & Refining Co. (Smelter.)

Coahuila: Torreon—American Metal Co. (Ltd.). (Cia. Metalúrgica de Torreon.) (Smelter.)

Hidalgo: Zimapan—Cia. Min. y Fundidora de Zimapan. (Smelter.)

Nuevo Leon:
- Monterrey—American Metal Co. (Ltd.). (Cia. Minera de Peñoles—S. A.) (Smelter and refinery.)
- Monterrey—American Smelting & Refining Co. (Smelter and refinery.)

San Luis Potosi: San Luis Potosi—American Smelting & Refining Co. (Cia. Minera Asarco.) (Smelter.)

Zacatecas: La Fé—American Metal Co. (Ltd.). (Cia. Minera de Peñoles—S. A.) (Smelter.)

TARIFF

The tariff act of 1930 became effective June 18, 1930. The only change in the lead schedules from the 1922 act was in the item "Articles or wares not especially provided for, if composed wholly or in chief value of lead, but not plated with platinum, gold, or silver, or colored with gold lacquer, whether partly or wholly manufactured." The import duty on articles coming under this classification was increased from 40 per cent to 45 per cent ad valorem. The following table gives the duties on the principal lead items under the new act.

Import duties on lead commodities under the tariff act of 1930

Paragraph	Item	Import duty
391	Lead-bearing ores, flue dust, and matte of all kinds. (Duty shall not apply to lead content of copper, gold, or silver ores, or copper mattes unless actually recovered.)	1½ cents per pound on lead content.
392	Lead bullion or base bullion, lead in pigs and bars, lead dross, reclaimed lead, scrap lead, antimonial lead, antimonial scrap lead, type metal, Babbitt metal, solder, all alloys or combinations of lead not specially provided for.	2⅛ cents per pound on lead content.
	Lead sheets, pipe, glazier's lead, and lead wire	2⅜ cents per pound on lead content.
397	Articles or wares n. s. p. f., if composed wholly or in chief value of lead, but not plated with platinum, gold, or silver, or colored with gold lacquer, whether partly or wholly manufactured.	45 per cent ad valorem.
72	Lead pigments:	
	Litharge	2½ cents per pound.
	Orange mineral	3 cents per pound.
	Red lead	2¾ cents per pound.
	White lead	2½ cents per pound.
	All pigments containing lead, dry or in pulp, or ground in or mixed with oil or water, n. s. p. f.	30 per cent ad valorem.
46	Lead chemicals:	
	Acetate, white	2½ cents per pound.
	Acetate, brown, gray, or yellow	2 cents per pound.
	Nitrate, arsenate and resinate	3 cents per pound.
	All other lead compounds, n. s. p f.	30 per cent ad valorem.

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[3] Subsidiary of Anaconda Copper Mining Co

[5] Plant idle in 1929.

WORLD ASPECTS

WORLD SMELTER PRODUCTION

The following table shows the world smelter production of lead from 1925 to 1929, so far as statistics are available. Official figures are used wherever possible. For countries for which official data are not yet available the figures are taken from the yearbook of the American Bureau of Metal Statistics and other reliable sources, but in later reports the official statistics will be substituted as received.

There is always a possibility of duplication in figures showing world production, for some countries send "work lead" or base bullion to other countries for refining. Furthermore, secondary and antimonial lead are often included in the figures showing the foreign production, so that to put the United States on an equal footing in the statistics it would be necessary to include in its production the domestic output of secondary lead and antimonial lead. The figures for the United States represent refined lead that was smelted in this country, whatever the source of the ore.

World production of lead, 1925–1929, in metric tons [1]

[Compiled by L. M. Jones, of the Bureau of Mines]

Country [2]	1925	1926	1927	1928	1929
Argentina	7,700	8,200	7,800	8,991	9,720
Australia	151,269	155,398	167,616	157,565	180,358
Austria	5,408	6,478	8,086	8,135	6,569
Belgium	87,480	87,876	91,710	86,260	[3] 86,000
Canada	104,303	123,644	134,157	136,561	138,095
Chosen	485	1,958	824	719	333
Czechoslovakia	2,212	2,316	2,502	3,065	4,609
France	20,543	19,495	24,973	22,911	20.500
Germany [4]	70,500	76.600	84.000	87,000	97,900
Great Britain	4,811	4,334	6,132	8,638	10,839
Greece	5,366	5,059	5,325	7,306	8,500
India (Burma)	48,034	55,202	67,026	79,642	81,521
Indo-China	------------	1	4	[3] 5	17
Italy	24,475	23,590	23,774	21,220	21,950
Japan	3,337	3,610	3,394	3,653	3,400
Mexico	163,242	182,886	210,996	223,024	233,154
Northern Rhodesia	3,406	3,897	5,951	4,751	1.661
Norway	406	385	[3] 300	[3] 300	[3] 300
Peru	115	122	171	14,466	19,448
Poland	28,637	27,924	29,574	36,448	36,507
Portugal	60	140	60	84	[3] 80
Rumania	489	655	828	537	565
Russia [5]	1,021	1,342	1,217	2,065	8,000
South-West Africa [6]	1,619	1,682	3,535	5,004	3,384
Spain	153,567	149,514	144,023	130,950	142,753
Sweden	723	522	330	------------	------------
Tunisia	16,013	18,106	18,662	17,606	18,850
Turkey	4,786	6,014	7,852	6,962	6,499
United States (refined) [7]	636,790	661,239	635,651	592,238	636.997
Yugoslavia	10,956	9,809	10,672	13,875	9,471
	1,558,000	1,638,000	1,697,000	1,680,000	1,788,000

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[1] By countries where smelted but not necessarily refined.

[2] In addition to the countries listed, China smelts lead, but no reliable data of output are available. Official estimates of production in 1925 range from 1,500 to 3,500 tons.

[3] Approximate production.

[4] Exclusive of secondary material. (Metallgesellschaft, Berlin.)

[5] Year ended Sept. 30.

[6] Year ended Mar. 31 of year following that stated.

[7] Figures cover domestic refined and lead refined from foreign ore.

The world smelter production of lead in 1929, as compiled by the Bureau of Mines, amounted to 1,788,000 metric tons, an increase of

6 per cent over the 1928 output and the largest annual output recorded to date. The American Bureau of Metal Statistics estimates the 1929 output at 1,755,519 metric tons, an increase of 5 per cent over its estimate of the 1928 output. The Metallgesellschaft, of Frankfort on the Main, reports the 1929 world output at 1,738,000 metric tons, or 6 per cent over the 1928 output.

The following table shows the rank in lead production of the various countries that produced 1 per cent or more of the world total in 1928 and 1929.

Rank of the lead-producing countries contributing 1 per cent or more of the world's lead in 1928 and 1929

Rank	1928			1929		
	Country	Production		Country	Production	
		Per cent	Cumulative per cent		Per cent	Cumulative per cent
1	United States	35.3	35.3	United States	35.6	35.6
2	Mexico	13.3	48.6	Mexico	13.0	48.6
3	Australia	9.4	58.0	Australia	10.1	58.7
4	Canada	8.1	66.1	Spain	8.0	66.7
5	Spain	7.8	73.9	Canada	7.7	74.4
6	Germany	5.2	79.1	Germany	5.5	79.9
7	Belgium	5.1	84.2	Belgium	4.8	84.7
8	India	4.7	88.9	India	4.6	89.3
9	Poland	2.2	91.1	Poland	2.0	91.3
10	France	1.4	92.5	Italy	1.2	92.5
11	Italy	1.3	93.8	France	1.2	93.7
12	Tunisia	1.0	94.8	Peru	1.1	94.8
13				Tunisia	1.1	95.9
	Other countries	5.2	100.0	Other countries	4.1	100.0
	World	100.0		World	100.0	

All but two of the countries named in the table given above produced more lead in 1929 than in 1928.

The largest tonnage increase (44,800 metric tons, or 8 per cent) was in the United States. Other countries showing substantial increases were Australia, 22,800 tons, or 14 per cent; Spain, 11,800 tons, or 9 per cent; Germany, 10,900 tons, or 13 per cent; Mexico, 10,100 tons, or 5 per cent; Russia, 5,900 tons, or 286 per cent; and Peru, 5,000 tons, or 34 per cent.

The largest tonnage decrease (4,400 metric tons, or 32 per cent) was in Yugoslavia. Relatively substantial decreases also were reported in Northern Rhodesia, South-West Africa, France, and Austria.

SUMMARY OF LEAD INDUSTRY IN IMPORTANT LEAD-PRODUCING COUNTRIES

ALGERIA

Lead ore produced in Algeria is smelted in Europe. In 1929, 14,227 metric tons of lead and lead-silver ore averaging 56 per cent lead was produced, as compared with 13,409 tons of 57.1 per cent ore in 1928. Exports of lead ores amounted to 20,156 tons, which included some shipments from other countries, probably Tunisia and Morocco.

ARGENTINA

Argentina ranked second in South American lead production in 1929, with an output of 9,720 metric tons, an increase of 8 per cent over 1928. The 1929 smelter output included 3,900 tons of lead from Argentine ores, as compared with 2,800 tons in 1928. The remainder was obtained from ores imported from Bolivia. The 1929 mine output amounted to 5,024 tons of 75 per cent concentrates.

AUSTRALIA

Australia ranked third in lead production in 1929, with an output of 180,358 metric tons, an increase of 14 per cent over 1928 and equal to 10.1 per cent of the world total. All but a small part of the lead ore mined in Australia, most of which was derived from the Broken Hill district, New South Wales, was smelted at Port Pirie, the only active lead smelter in Australia. Mine production of lead in 1929 amounted to 197,120 metric tons, of which 91 per cent was contained in Broken Hill lead concentrates, 4 per cent in Broken Hill zinc concentrates, and 5 per cent in ores from other districts. Exports of pig lead and lead bullion in 1929 amounted to 155,354 tons, and exports of lead in ore and concentrates amounted to 14,329 tons. Europe took 95 per cent and Japan 3 per cent of the pig lead and lead bullion exported in 1929.

The production and ore reserves of the five principal producers in the Broken Hill district in 1929 are shown in the following table:

Production and ore reserves of the five principal producers in the Broken Hill district in 1929

	Zinc Corporation	Broken Hill South	North Broken Hill		Sulphide Corporation	Broken Hill Proprietary	
	Ore	Ore	Ore	Dump material	Ore	Ore	Dump material
Material treated ... long tons	287,407	320,760	435,668	50,340	135,560	30,689	155,744
Lead content ... per cent	15.3	14.3	14.2	11.5	14.0	(1)	(1)
Zinc content ... do	10.4	11.1	11.0	14.7	14.2	(1)	(1)
Silver content ... ounces	3.4	5.3	8.1	8.6	11.1	(1)	(1)
Lead concentrates produced ... long tons	63,270	64,989	93,240	8,249	25,077	5,852	21,834
Lead content ... per cent	65.4	66.5	62.8	55.8	63.7	(1)	(1)
Zinc content ... do	6.9	6.3	8.0	11.8	8.2	(1)	(1)
Silver content ... ounces	13.8	23.8	32.6	39.5	48.6	(1)	(1)
Lead recovered ... per cent	94.0	94.1	94.1	79.4	79.2	(2)	(2)
Silver recovered ... do	90.5	90.3	85.6	75.4	77.4	(2)	(2)
Zinc concentrates produced ... long tons	51,557	58,785	74,460	12,947	33,706	6,467	1,015
Zinc content ... per cent	47.5	49.5	49.3	46.6	50.1	(1)	(1)
Lead content ... do	3.3	2.3	2.8	5.4	3.8	(1)	(1)
Silver content ... ounces	1.2	1.6	3.6	5.4	6.4	(1)	(1)
Zinc recovered ... per cent	81.7	82.0	76.6	81.2	80.2	(2)	(2)
Ore reserves ... long tons	[3] 2,956,056	[4] 4,250,000	[4] 4,000,000	-------	[5] 1,405,470	(2)	(2)
Lead content ... per cent	[3] 13.9	(1)	(1)	-------	(1)	(2)	(2)
Zinc content ... do	[3] 11.3	(1)	(1)	-------	(1)	(2)	(2)
Silver content ... ounces	[3] 3.0	(1)	(1)	-------	(1)	(2)	(2)

[1] Assays not given.
[2] Data not available.
[3] Tons as of Dec. 31, 1929; assays as of Dec. 31, 1927.
[4] As of June 30, 1929.
[5] As of June 30, 1928.

The increased lead production of the Broken Hill district in 1929 may be attributed to the increase in the price of lead during the first half of the year and to the desire of the producers to take final advantage of their agreement with the British Board of Trade under which they were able to dispose of zinc concentrates at a price considerably above the London quotation. The agreement expired in June, 1930, and with the low metal prices and relatively high wages current at that time some of the Broken Hill producers were forced to curtail operations. Broken Hill Proprietary was reported to have shut down September 1, 1930, and North Broken Hill and Broken Hill South, two of the largest producers in the district, discontinued the production of zinc concentrates entirely. At the expiration of the contract the board of trade was reported to have on hand in Australia more than 200,000 tons of zinc concentrates. The total loss to the board from April, 1918, to March, 1929, was £5,800,000.

The Lake George mine at Captain's Flat, New South Wales, near Canberra, is being developed by the National Mining Corporation (Ltd.). Ore reserves as of July 31, 1929, were estimated [6] at 1,921,316 tons, containing 7.54 per cent of lead, 12.86 per cent of zinc, 0.76 per cent of copper, 2.37 ounces of silver, and 1.27 pennyweight gold. The lode is said to be capable of yielding 5,000,000 tons of ore. Negotiations are under way for a 21-mile railway from Bungendore to Captain's Flat, and plans are being prepared for a plant capable of treating 180,000 tons annually.

In Queensland the development and construction programs at Mount Isa [7] are well under way. The first 500-ton unit of the 2,000-ton mill was expected to be operating in August, 1930, and smelting was to have started before the end of 1930, but owing to an interruption in transportation and a large inrush of water into the mine workings caused by an exceptionally heavy rainfall production will probably be delayed until the first part of 1931. On the basis of 2,000 tons of ore per day, an annual production of 70,000 tons of lead, 3,000,000 ounces of silver, and 4,800 tons of zinc concentrates is expected. The mill eventually will be enlarged to treat 5,000 tons of ore daily; present plans provide for the erection of an electrolytic zinc plant some time in the future. Ore reserves were estimated at 28,000,000 tons as of April 30, 1930.

According to press reports the American Smelting & Refining Co. acquired approximately a one-fifth interest in Mining Trust (Ltd.), which controls Mount Isa, and at the same time assumed the technical management of the Mount Isa property for a period of 10 years.

Another Queensland lead-zinc-silver area which may become an important producer is Lawn Hills, 110 miles from Burketown, Gulf of Carpentaria. This deposit has been known for years, but development has been hindered by lack of transportation. In 1929 Mining Trust (Ltd.) secured exclusive prospecting rights on 100,000 acres for five years from the Queensland Government. In April, 1930, it was reported that three diamond drills were in operation and that ore had been proved to a depth of 200 feet over an area 600 feet long and 60 feet wide. The ore is said to be low grade so that large-scale operations will be required.

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[6] Industrial Australian and Mining Standard, May 22, 1930, p. 374.

[7] Callow, J. M., The Mine and Smelter at Mount Isa: Min. Mag. (London), vol. 41, November, 1929, p. 336.
Mitke, C. A., The Mount Isa Project Development Plans and Mining Methods: Eng. and Min. Jour., vol. 128, Dec. 21, 1929, p. 954

In June, 1929, the discovery of important lead and copper deposits in the Jervois Range district, 210 miles from Alice Springs, Central Australia, was reported. A year later one company reported a reserve of 600,000 tons of lead and copper ore. The lead ore contained 23 per cent of lead and 10 ounces of silver and the copper ore 12.6 per cent of copper and 23 ounces of silver. First reports of the size of the deposits were said to have been exaggerated. Lack of available timber and water and the distance of the deposits from rail transportation will seriously retard the development of the district.

In Tasmania the Electrolytic Zinc Co. completed experimental work on the treatment of the lead-zinc-silver ores of the Mount Read and Rosebery group of mines and began construction of a 500-ton mill. The plant was expected to start in January, 1931, if market conditions were satisfactory.

BELGIUM

Belgium ranked third in European lead production and seventh in world production in 1929. Its output in 1929 has been estimated at 86,000 metric tons, which was about equal to the 1928 output. The mines of Belgium produce little lead ore, so that the smelting industry depends on imports for its raw materials. In 1929 Belgium imported 42,424 tons of lead ore, as compared with 59,215 tons in 1928, and 31,338 tons of lead in pigs (probably mostly base bullion) and scrap, as compared with 21,395 tons in 1928. Another important source of lead in Belgium is the residue from the smelting of imported zinc ores. Belgium exported 21,030 tons of pig lead and scrap and 15,514 tons of lead in sheets, pipes, etc., in 1929.

BOLIVIA

Bolivia produces considerable lead ore, all of which is exported. In 1929, 19,615 metric tons of ore and 1,990 tons of slag containing 71.84 and 43.47 per cent of lead, respectively, were exported, of which Belgium took 11,875 tons and Argentina 7,309 tons. The 1928 exports amounted to 17,415 metric tons of 71.35 per cent ore and 603 tons of 46.43 per cent slag.

CANADA

Canada produced 152,225 short tons of lead in 1929, a slight increase over the 1928 output. Canada ranked fifth in world production in 1929, having lost fourth place to Spain whose output had increased considerably. Mine production amounted to 163,261 short tons in 1929, a decrease of 5,700 tons from 1928. British Columbia supplied 94 per cent of the 1929 mine output, Yukon 3 per cent, Quebec 2 per cent, and Ontario 1 per cent. Canada exported 114,187 tons of pig lead in 1929, or 75 per cent of the smelter output. Great Britain took 45 per cent of it and Japan 35 per cent. Exports of lead in ore amounted to 7,988 tons.

British Columbia.—By far the largest part of the lead production of Canada is derived from the Sullivan mine of the Consolidated Mining & Smelting Co., in British Columbia. In 1929, 1,778,000 tons of ore was produced from this mine, as compared with 1,502,348 tons in 1928. Total shipments of ore to the end of 1929 are estimated at 10,178,000 tons.

During 1929 the company began construction of an addition to the Kimberley mill, which treats the Sullivan ore, and at the end of the year the mill was 80 per cent complete. This addition will increase the capacity to 6,000 tons of ore daily. The company issues no statement of ore reserves, but in January, 1930, officials of the company were reported [8] to have stated that the reserves were sufficient to operate the mill 30 to 50 years at the present rate and that production costs of lead and zinc were the lowest in the world. At a later date it was reported [9] that diamond drilling has proved the ore body to be of commercial size and grade at a vertical depth of 1,000 feet below the 3,900-foot level, the lowest now working. Owing to the dip of the vein, 2,000 feet of ore has thus been established below the 3,900-foot level. The company also owns large reduction works at Tadanac and Trail, British Columbia, where the ore from its own and other independent mines is treated. The company's production of principal metals during the past three years has been reported as follows:

	1927	1928	1929
Gold ounces	29, 490	23, 623	14, 694
Silver do	7, 179, 607	7, 673, 762	7, 362, 164
Lead pounds	291, 043, 120	318, 831, 578	300, 433, 924
Copper do	18, 522, 742	17, 806, 306	8, 346, 632
Zinc do	147, 054, 623	163, 530, 890	172, 096, 841

The slag furnace at the Tadanac smelter, which was designed to recover by volatilization about 100 tons of lead and zinc daily from the lead blast-furnace slag containing 15 to 20 per cent of zinc, was 60 per cent complete at the end of the year.

The total mine production of lead in British Columbia in 1929 amounted to 154,000 short tons, of which the Sullivan mine (Fort Steele district) produced 96 per cent. The remaining 4 per cent came largely from the Slocan, Portland Canal, and Ainsworth districts. Most of the mines in these districts have small outputs, and many of them had suspended operations early in 1930 as a result of low metal prices.

The 350-ton mill of the Base Metals Mining Corporation, of Field, British Columbia, was put into operation in November, 1929. The ore at this property is said to run 18 per cent of lead, 12 per cent of zinc, and 2 to 3 ounces of silver. A 70 per cent lead concentrate and a 55 per cent zinc concentrate are obtained by flotation with very high recoveries.

Yukon Territory.—Yukon Territory was second in importance in lead production and was the only Province to show an increase in 1929. The principal producer was the Treadwell Yukon Co., which operates in the Mayo district. This company reported the finding of several new ore bodies and extensions to known ore bodies. Considerable prospecting was in progress during the year, and transportation facilities were greatly improved. A large part of the ore from the Mayo district is shipped to Idaho forsmelting.

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[8] Canadian Mining Journal, vol. 51, Jan. 3, 1930, p. 9.

[9] New York Times, May 4, 1930.

Quebec.—All of the lead produced in Quebec in 1929 came from the Tétreault mine at Notre Dame des Anges, which was operated by the British Metal Corporation (Ltd.). On December 20, 1929, the mine was closed down and the lease returned to the owners, who planned to resume exploration and development. The mine has been operated almost continuously since 1911 and in these 19 years has produced a total of more than 800,000 tons of ore averaging roughly 9 per cent of zinc, 3 per cent of lead, 0.09 ounce of gold, 8.3 ounces of silver, and 0.1 per cent of copper.

Ontario.—The principal lead producer in Ontario is the Kingdon Mining, Smelting & Manufacturing Co., at Galetta. The ore is galena in a calcite gangue; 2,101 tons of lead was produced in 1929 at the smelter from 102,000 tons of ore mined. Elsewhere in Ontario small quantities of lead were produced as a by-product of the smelting of silver-cobalt ores and from concentrates exported from the Errington mine of the Treadwell Yukon Co. (Ltd.).

The Treadwell Yukon Co. (Ltd.) operated a 250-ton concentrator at the Errington mine and made considerable progress in the treatment of the ore. In April, 1930, it was announced that mill recoveries were as follows: Zinc, 80 per cent; copper, 70 per cent; lead, 60 per cent; and precious metals, 50 per cent. Pending further experimentation on ore treatment, the company decided to sink an additional 1,500 feet, and should the ore body at that level prove to be equal to the showing on the 500 level a 2,000-ton concentrator is to be built. The average assay of all ore bodies as of April, 1930, was 4.55 per cent zinc, 1 per cent lead, 1.05 per cent copper, 1.65 ounces of silver, and 0.03 ounce of gold.

Assuming an over-all recovery of 73 per cent, $1 per ton for the sulphur content of the pyrite concentrates, copper at 15 cents, lead and zinc at 5½ cents, and silver at 40 cents, a profit of $2.20 per ton is estimated on the basis of a daily capacity of 2,000 tons.

Sudbury Basin Mines (Ltd.) developed additional ore on its property. Plans for the exploitation of this deposit are awaiting developments at the adjoining Errington mine.

Northwest Territories.—Development of the Great Slave Lake lead-zinc deposits was started by the Northern Lead Zinc Co., owned jointly by Consolidated Mining & Smelting Co., Ventures (Ltd.), Atlas Exploration Co., and a Boston syndicate. Five deposits had been found up to the end of 1929, but the commercial possibilities had not been established at that time. The deposits appear to be similar to the tri-State deposits and consist of galena and sphalerite replacement in dolomite. A 55-foot test shaft averaged 22.3 per cent of lead and 13.6 per cent of zinc, the principal values being in the upper 30 feet. The deposit is practically free of silver.

FRANCE

France produced 20,500 metric tons of lead in 1929, a decrease of 11 per cent from the 1928 output. This supplied only one-fifth of the country's needs; the balance was supplied by imported lead, chiefly from Spain, Mexico, and Tunisia. The lead-smelting industry of France depends somewhat on imported ore; nearly 35,000 tons was imported in 1929. The principal lead mines of France are in the southern part of the country.

The mill capacity at Villemagne was increased to 450 tons. During 1929, 144,000 tons of ore was mined and 132,900 tons was treated. Operations for the year resulted in a loss, including depreciation, of more than 4,000,000 francs.

GERMANY

Production of primary lead in Germany increased from 87,000 metric tons in 1928 to 97,900 tons in 1929. The apparent consumption of crude lead in 1929 amounted to 212,400 tons. Imports in 1929 amounted to 137,000 tons, of which Australia supplied 24 per cent, United States 23 per cent, Mexico 17 per cent, and British India 12 per cent. Germany ranks second to Great Britain as an importer of pig lead. Exports of pig lead amounted to 22,400 tons.

According to the Metallgesellschaft, the mine production of lead in Germany in 1929 amounted to 52,000 tons, or 53 per cent of the smelter output. The remainder of the lead smelted was supplied by 79,500 tons of ores and scrap imported from many parts of the world. About 20,000 tons of lead ore produced in Upper Silesia was exported to Poland.

GREAT BRITAIN

Great Britain ranks second to the United States in the consumption of pig lead; 274,300 metric tons was consumed in 1929, an increase of 12 per cent over 1928. The smelting industry supplied only 11,000 tons, while imports amounted to 298,000 metric tons, of which Australia supplied 30 per cent, United States 23 per cent, Canada 16 per cent, and Mexico 6 per cent. Imports from the United States increased 42 per cent in 1929. In 1929 Great Britain exported 33,000 tons of pig lead and about 6,800 tons of lead sheets, pipe, foil, etc.

Metallgesellschaft estimates the 1929 mine production of lead in Great Britain at 15,000 tons.

INDIA

The lead production of India in 1929 was 81,521 metric tons, an increase of 2 per cent over the 1928 output and equal to nearly 5 per cent of the world total. This was the fourth successive yearly increase since 1925, when 48,000 tons was produced. Exports of lead from India in 1929 were about 78,000 metric tons, of which Great Britain received 84 per cent, Japan 8 per cent, and Ceylon 4 per cent.

The only lead producer of any importance in India is the Burma Corporation (Ltd.). Its mines are at Bawdwin in the Upper Shan States of Burma. During the year ended June 30, 1929, the company mined 463,057 long tons of ore averaging 22.6 per cent of lead, 12.9 per cent of zinc, 1.07 per cent of copper, and 19.7 ounces of silver, bringing the total ore mined from the starting of operations to 3,115,518 tons. The metal output for the fiscal year was 78,716 long tons of refined lead, 7,376,841 ounces of refined silver, 60,180 tons of 51 per cent zinc concentrates, 1,227 tons of refined antimonial lead, and 10,719 tons of copper matte. Ore reserves as of July 1, 1929, were 4,149,263 tons averaging 25.8 per cent of lead, 15.7 per cent of zinc, 21.2 ounces of silver, and 1.05 per cent of copper.

ITALY

Smelter production of lead in Italy increased from 21,220 metric tons in 1928 to 21,950 tons in 1929. The 1929 output was about 1 per cent of the world total and less than half of the country's needs. Imports of pig lead and scrap amounted to 24,664 tons in 1929.

The mines of Italy produced 52,470 tons of lead ore in 1929, as compared with 55,369 tons in 1928. Exports amounted to 12,707 tons in 1929 and 19,139 tons in 1928. The principal lead-producing area in Italy is the Iglesias district in the island of Sardinia.

JAPAN

Japan ranks fifth in world consumption of lead and is largely dependent on imports. The estimated consumption in 1929 was 64,000 metric tons. Domestic production amounted to only 3,400 tons and imports amounted to about 61,000 tons, of which Canada supplied 53 per cent, United States 31 per cent, and Australia and India 16 per cent. Imports from Canada increased 10 per cent in 1929, while those from the United States decreased 29 per cent.

MEXICO

Mexico has ranked second in world lead production for several years. In 1929 it produced 233,000 metric tons of pig lead, 13 per cent of the world total and 5 per cent more than its 1928 output. According to Metallgesellschaft, the mine production of lead in Mexico in 1929 amounted to 248,700 tons, an increase of 5 per cent over the 1928 output. About 60 per cent of the mine output comes from Chihuahua. Other leading States are Zacatecas, Coahuila, Durango, and San Luis Potosí.

The mining industry of Mexico was interrupted by revolution in March and April, but stimulated by the rise in the price of lead which resulted from the threat of diminished supply the lead mines rapidly recovered their output and production was maintained at a high rate during the remainder of the year. The new $1,000,000 refinery of the American Smelting & Refining Co. at Monterrey began operating in April, and as a result the exports of base bullion to the United States dropped 47 per cent while the exports of refined lead to Europe increased correspondingly. The American Metals Co. added a bag house and Dwight-Lloyd sintering plant to its smelter at Torreon, Coahuila.

NEWFOUNDLAND

Newfoundland produces some lead ore chiefly from the Buchans mine; the property is owned jointly by the Anglo-Newfoundland Development Co. and the American Smelting & Refining Co., the latter of which operates the property. During the year ended November 30, 1929, 166,536 tons of ore was milled, from which 73,508 tons of concentrates was produced. The estimated gross operating profit before deduction of interest and amortization charges amounted to more than $1,000,000, or $6.59 per dry short ton mined. The mill capacity was being increased from 500 to 1,000 tons per day, and early in 1930 it was reported that the erection of a $500,000 smelter at Red Lake was being considered. Ore reserves as of December 1, 1929, including assured and highly probable ore, amounted to 7,159,464 tons, averaging 16.27 per cent of zinc, 7.28 per cent of lead, 1.13 per cent of copper, 3.64 ounces of silver, and 0.04 ounce of gold, or an increase of more than 1,000,000 tons over the estimate for the previous year.

PERU

The smelter production of lead in Peru in 1929 amounted to 19,448 metric tons, an increase of 34 per cent over the 1928 output. The lead is produced in the form of base bullion, which is refined in the United States. Mine production decreased from 31,650 tons to 28,266 tons. The principal lead-producing districts are Colquijirca, Casapalca, and Alpamina, and the principal company is the Cerro de Pasco Copper Corporation. During 1929 this company increased its output of lead and was building a new concentrator to treat the lead-zinc ores of Casapalca. A second lead furnace was being constructed at Oroya. The furnace was expected to be operating in 1930 and the new mill in 1931. A 25-ton test mill to treat lead-zinc ores of Cerro de Pasco should be operating in 1930.

RUSSIA

The production of lead in Russia increased from 2,065 tons in 1928 to 8,000 tons in 1929, which was by a wide margin the largest output ever recorded. Imports amounted to 32,000 tons, indicating an approximate consumption of 40,000 tons. Imports from the United States in 1929 have been reported at 1,800 tons.

V. Karmashov, of the technical bureau, nonferrous metal industry of the Union of Socialist Soviet Republics, states[10] that the following plants for producing lead are being considered:

	Present annual pure-metal capacity	Planned annual pure-metal capacity
	Metric tons	*Metric tons*
Ridder lead plant, Altai Mountains	5,000	18,000
Alagir lead plant, North Caucasus	1,000	5,000
Chimkent lead plant, Turkestan, 45 per cent lead in ore, without other metals	New.	50,000
Nerchinsk lead plant, East Siberia	New.	20,000
Moscow lead smelting and refining plant, for secondary lead	New.	50,000
	6,000	143,000

He reported that the Alagir plant was being expanded and that the first unit of the Ridder project was finished and a second unit under construction. The other plants were being designed, and construction was expected to begin before the end of the year (1930).

The Tetiuhe Mining Corporation (Ltd.), a subsidiary of Selection Trust (Ltd.), is operating a lead-zinc-silver property in eastern Siberia, about 250 kilometers north of Vladivostok, under a concession from the Soviet Government. During the year ended September 30, 1929, 50,487 tons of ore assaying 15.06 per cent of zinc and 10.49 per cent of lead was treated, and 13,923 tons of 45.06 per cent zinc concentrates and 6,335 tons of 74.47 per cent lead concentrates were produced. The lead concentrates contained 58.35 ounces of silver per ton. Operations were conducted at a loss, but profitable operations were expected to result from the completion of additional mill capacity and a lead smelter in 1930.

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[10] Karmashov, V., Nonferrous Metal Industry of Soviet Russia: Eng. and Min. Jour., vol. 130, July 24, 1930, p. 67.

SPAIN

Spain produced nearly 143,000 metric tons of pig lead in 1929, an increase of 9 per cent over the 1928 output and equal to 8 per cent of the world total. Exports amounted to 99,600 tons, of which 2,400 tons was argentiferous lead. France took 33 per cent of the total, England 17 per cent, Russia 16 per cent, and Italy 13 per cent. The mine production of Spain in 1929 amounted to 180,890 tons of ore containing from 25 to 70 per cent of lead, as compared with 177,059 tons in 1928. Fifty-three per cent of the 1929 output came from the Province of Jaen, 18 per cent from Cordoba, 13 per cent from Murcia, and 5 per cent from Ciudad Real. The low price of lead prevailing during the latter part of 1929 and the early part of 1930 is reported to have resulted in the closing down of many of the smaller properties. Only the richest of the mines, or those where lead is found in large quantities and near the surface, are able to operate.

TUNISIA

Tunisia produced 18,850 metric tons of pig lead in 1929, as compared with 17,606 tons in 1928. Exports of pig lead in 1929 amounted to 18,296 tons, 88 per cent of which went to France. Production of lead ore was reported at 32,000 tons in 1929 and 34,000 tons in 1928.

YUGOSLAVIA

Developments in the lead industry of Yugoslavia in 1929 have been summarized by the Mining Journal [11] (London) as follows:

> The country's output in lead ores advanced in 1929 to 26,250 tons, against 15,886 tons in the preceding year; the bulk of the production emanated from the Slovenian properties of the Central European Mines (Ltd.). This company treats imported parcels of ore, which swell the figures of the lead output from their smelter. Official returns appear to indicate that roughly some 9,460 tons of pig lead were produced in Yugoslavia during the year. Toward the close of the year lower metal prices began to adversely affect the production of lead ores by small producers. The foregoing figures solely refer to lead ores mined, smelted or sold, and do not take into account the considerable tonnage of lead-zinc ores which are being accumulated at surface on some of the Southern Serbia and Macedonia properties and await treatment. In July, 1929, the issue in London and oversubscription of 1,600,000 shares of Trepca Mines (Ltd.) attracted attention to this very promising enterprise, which has been hard at work since 1926 exploring and developing the Stantrg ore deposits near Kosovska Mitrovica. These deposits have now been sufficiently opened up for the estimate to be made that there are close upon three million tons of good-grade lead-zinc ore above the level of the lowest adit. Since last summer secondary development has been proceeding apace, and a very substantial tonnage is now blocked out; an aerial ropeway, a power plant, and a fine modern 500-ton mill are approaching completion. It is hoped that toward the autumn the producing stage will be reached, and even with to-day's depressed metal prices this concern should be able to give a very good account of itself. The company's concession and prospecting rights cover roughly 400 square miles, and there are indications of ancient mining operations in several localities, notably at Meljenica and

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[11] Mining Journal (London): Vol. 170, July 26, 1930, p. 603.

Trepca Hill, where recent exploration has shown ore bodies to exist intact beneath the old surface and underground workings. It was reported that the original prospectors of this concession located some float ore which, on analysis in the Government laboratories, showed values of over half an ounce of gold per ton, and it seems possible that systematic prospecting may eventually reveal the source of this eroded material. To the south of the Trepca Concession are the extensive areas held by Novo Brdo Mines (Ltd.). This company amalgamated a few months ago with a sister concern, Janjevo Mines (Ltd.), the merger being the normal outcome of a situation in which the small Janjevo concession was completely surrounded by the big holdings of the Novo Brdo Co. The joint capital is now £300,000 sterling, which should be sufficient to continue the development of the lead-zinc ore bodies of the Janjevo mines and to further examine the extensive tract of ancient workings which occur on the Novo Brdo areas. More recently Selection Trust (Ltd.) have registered in London two other companies to take over concessions in Serbia; these are Belasica Mines (Ltd.) and Kopaonik Mines (Ltd.), each having a capital of £137,500 sterling. The concessions acquired are situated to the north of the Trepca areas and in the vicinity of Mount Kopaonik. It is in the Savic concessions extending northward from this mountain that the French concern, the Penarroya Co., have been for some time past exploring the series of ancient workings known as the Plana Mine. The American Smelting & Refining Co. acquired a year or two ago the Srebrenitsa Concession in Bosnia. This is once again an extensive concession comprising an ancient center of mining operations which was also a scene of mining activity during the Middle Ages. So far however, the opening up of the property has not been proceeding very vigorously.

IMPORTS

The United States imports much lead in various forms, principally in base bullion and ore. Some of it is entered for immediate consumption; most of it, however, is entered for warehouse, is smelted and refined in bond, and is then reexported as refined pig lead or in manufactured products.

GENERAL IMPORTS

The following table shows the general imports of lead into the United States, by classes, including both imports for immediate consumption and imports for warehouse. Of the total lead imported in 1929, as shown in the table, 71. 6 per cent was in base bullion, 27.0 per cent in ore, and 1.4 per cent in pigs, bars, sheets, and old. Imports in base bullion decreased 35 per cent, while imports in ore and in pigs, bars, etc., increased 21 per cent and 151 per cent, respectively. Total imports of lead decreased 25 per cent in 1929.

Lead imported into the United States, 1920–1929, by classes, in pounds

[General imports]

Year	Lead in ore	Lead in base bullion	Pigs, bars, sheets, and old	Total lead content
1920	29, 488. 816	96, 103, 603	71, 437, 108	197, 029, 527
1921	14, 234. 039	71. 733, 838	62, 602, 534	148, 570, 411
1922	24, 474, 481	124, 074, 465	7, 101, 623	155, 650, 569
1923	66, 882, 850	161, 496, 495	42, 198, 848	270, 578, 193
1924	95, 320, 168	155, 501, 350	24, 493, 746	275, 315, 264
1925	88, 962, 502	141, 253, 559	14, 042. 369	244, 258, 430
1926	116, 232, 669	156, 570, 738	22, 304, 620	295, 108, 027
1927	81, 276, 126	236, 567, 252	4, 934, 749	322, 778, 127
1928	51, 829, 530	256, 935, 461	1, 323, 158	310, 088, 149
1929	62, 661, 371	166, 141, 916	3, 315, 481	232, 118, 768

General imports of lead by countries are shown in the next table. Mexico supplied nearly 76 per cent of the total, South America (principally Peru) 20 per cent, Canada 4 per cent, and Europe and other countries only small amounts. Imports from Mexico and Canada decreased 36 per cent and 37 per cent, respectively, while imports from South America increased 131 per cent. The decrease from Mexico was due to a large decline in imports of base bullion, while the decrease from Canada was due to lower imports of lead in ore. The increased shipments of base bullion from Peru and lead ore from Chile accounted for the increase of lead imports from South America.

Lead imported into the United States, in ore, base bullion, and refined, 1920–1929, by sources, in pounds

[General imports]

Year	Canada	Mexico	South America	Europe	Other countries	Total
1920	8, 199, 234	131, 815, 278	7, 085, 351	38, 766, 504	11, 163, 160	197, 029, 527
1921	8, 127, 158	106, 406, 238	2, 381, 365	30, 224, 701	1, 430, 949	148, 570, 411
1922	8, 663. 236	141. 216, 136	3, 803. 478	1, 454, 384	513, 335	155, 650, 569
1923	11, 399, 671	242, 352, 788	5, 300, 161	11, 004, 938	520, 635	270, 578, 193
1924	11, 022. 091	243, 161, 069	15, 820, 867	4, 857, 805	453, 432	275, 315, 264
1925	11, 646, 820	218, 873, 800	10, 621, 737	1, 594, 963	1, 521, 110	244, 258, 430
1926	12, 316, 740	254, 203, 852	24, 790, 075	3, 224. 504	572, 856	295, 108, 027
1927	6, 214, 867	300, 634, 815	14, 583, 513	1, 226, 049	118, 883	322, 778, 127
1928	14, 352, 967	275, 184, 287	20, 408, 574	56, 406	85, 915	310, 088, 149
1929	9, 023, 527	175, 872. 302	47, 052, 018	29, 441	141, 480	232, 118. 768

The following tables show the imports of lead in ore, matte, and base bullion, by countries.

Lead imported into the United States, in ore and matte, 1925–1929, by countries, in short tons

[General imports]

Country	1925	1926	1927	1928	1929
Mexico	32, 971	40, 239	30, 615	17, 055	23, 415
Canada	4, 978	5, 524	2, 558	7, 131	3, 953
Peru	1, 887	3, 642	3, 415	1, 170	1, 601
Chile	3, 216	7, 596	3, 877	504	2, 295
Other countries	1, 429	1, 115	173	55	67
	44, 481	58, 116	40, 638	25, 915	31, 331

Imports of lead in ore from Mexico increased 37 per cent in 1929, amounting to 75 per cent of the total. Imports from Chile and Peru increased considerably, while imports from Canada decreased 45 per cent.

Lead imported into the United States, in base bullion, 1925–1929, by countries, in short tons

[General imports]

Country	1925	1926	1927	1928	1929
Mexico	70, 505	77, 663	117, 938	119, 935	63, 458
Peru	----------	435	----------	8, 525	19, 605
Spain	----------	----------	336	----------	----------
Other countries	122	187	10	8	8
	70, 627	78, 285	118, 284	128, 468	83, 071

Imports of base bullion from Mexico in 1929, although 47 per cent less than in 1928, amounted to 76 per cent of the total. The decrease was due to the completion of additional refinery capacity during the year, which permitted an increase in the quantity of refined lead produced in Mexico. Imports from Peru increased 130 per cent owing to increased production in that country by the Cerro de Pasco Copper Corporation.

IMPORTS FOR CONSUMPTION

Statistics on imports for consumption, as shown in the tables that follow, include imports entered for immediate consumption and withdrawals from warehouse for domestic consumption. As most of the lead imported is smelted and refined in bond and reexported the total imported for consumption is considerably less than general imports. In 1929 imports for consumption were equivalent to only about 24 per cent of the general imports of lead.

Lead remaining in warehouse in the United States, December 31, 1920–1929, in pounds

[Stated in the form in which the material was entered for warehouse]

Year	Ore (lead content)	Base bullion (lead content)	Pigs, bars, and old	Year	Ore (lead content)	Base bullion (lead content)	Pigs, bars, and old
1920	32, 923, 299	69, 517, 026	2, 644, 576	1925	105, 884, 711	91, 725, 008	[1] 16, 565, 672
1921	13, 679, 465	24, 692, 350	693, 440	1926	114, 630, 697	107, 582, 653	[1] 21, 820, 057
1922	10, 470, 144	7, 076, 544	-------------	1927	99. 526, 339	126, 669, 674	[1] 19, 326, 011
1923	76, 031, 259	80, 306, 856	5, 234, 475	1928	97, 645, 207	137, 500, 524	8, 278, 733
1924	103, 474, 370	95, 007, 016	10, 090, 668	1929	120, 413, 999	150, 868, 776	2, 656, 648

[1] Includes lead in reclaimed scrap, as follows: 1925, 241,078 pounds; 1926, 397,433 pounds; 1927, 397,712 pounds. Corresponding figures for earlier years and for 1928 and 1929 are not recorded separately.

Lead imported for consumption in the United States, 1920–1929, by classes

Year	Lead in ore [1]		Lead in base bullion		Pigs, bars, and old [2]		Sheets, pipe, and shot		Not otherwise specified	Total value
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value		
1920	13, 700, 499	$908, 619	66, 816, 820	$3, 340, 600	68, 901, 959	$3, 887, 821	81, 396	$5, 483	$21, 328	$8, 163, 851
1921	6, 842, 807	327, 046	56, 819, 980	1, 668, 410	61, 909, 094	1, 972, 716	3, 087	140	11, 204	3, 979. 516
1922	23, 649. 851	812, 603	55, 859, 422	1, 815, 142	8, 563, 110	335, 924	6. 018	697	12, 286	2, 976, 652
1923	22, 420, 046	1, 190, 414	11, 124, 151	626, 201	42, 925, 265	2, 510, 466	19, 525	4, 495	90, 027	4. 421, 603
1924	65, 147, 976	3, 145, 791	28, 796, 402	1, 542, 167	27, 362, 392	1, 850, 862	11, 666	4, 384	138, 637	6, 681, 841
1925	12, 706. 508	672, 112	24, 747, 665	1, 823, 566	15, 464, 205	1, 038, 350	27, 579	10. 429	139, 533	3, 683, 990
1926	58, 752, 911	3, 393. 039	13, 341, 038	972, 758	24, 365, 570	2, 191, 658	864, 342	101, 322	62, 895	6, 721, 672
1927	70, 260, 478	4, 203, 897	14, 629, 606	925, 328	9, 933, 679	635, 807	988. 170	104, 890	52, 626	5, 922, 548
1928	46, 511, 508	2, 626, 231	13. 397, 455	560, 983	20, 488, 373	808, 359	775, 329	67, 131	134, 995	4, 197, 699
1929	21, 645, 699	1, 160, 533	12, 395, 696	627, 455	20, 178. 922	1, 052, 087	899. 595	78, 776	126, 966	3, 045, 817

[1] Includes also lead in matte beginning Sept. 22, 1922.

[2] Includes also imports of antimonial lead, antimonial scrap lead, babbitt metal, solder, etc., beginning with tariff of Sept. 22, 1922, except in 1925, 1926, 1927, 1928, and 1929, when antimonial lead is excluded.

Type metal [1] imported for consumption in the United States, 1920–1929

Year	Type metal		Lead content	
	Pounds	Value	Pounds	Percentage
1920	29, 887, 353	$1, 349, 495	25, 761, 543	86. 2
1921	38, 971, 351	1, 191, 553	30, 706, 845	78. 8
1922	44, 895, 120	1, 120, 814	33, 944, 199	75. 6
1923	(2)	431, 610	7, 353, 463	(2)
1924	(2)	100, 367	1, 288, 766	(2)
1925 [1]	6. 009, 161	463, 134	4, 309, 549	71. 7
1926 [1]	8, 621, 175	912, 331	7, 053, 849	81. 8
1927 [1]	878, 346	65, 049	666, 654	75. 9
1928 [1]	3, 990, 548	193, 177	3, 086, 770	77. 4
1929 [1]	5, 440, 857	180, 679	4, 849, 979	89. 2

[1] Classification for 1925 to 1929 is "Type metal and antimonial lead"; separate figures not recorded.

[2] Figures not available.

EXPORTS

The chief lead export of the United States is refined pig lead derived from the treatment of foreign ores and base bullion. Exports decreased 37 per cent in 1929 owing primarily to a 35 per cent decrease in imports of base bullion. Europe took 69 per cent of the total, Asia 25 per cent, South America 5 per cent, and North America and Africa 1 per cent. In Europe United Kingdom, Germany, and Sweden were the largest importers, while in Asia and South America Japan and Brazil ranked first. United Kingdom took 32 per cent and Japan 22 per cent of the total United States exports.

Refined pig lead exported from the United States, 1928 and 1929, by destinations

Destination	1928		1929	
	Short tons	Value	Short tons	Value
North America:				
Canada	132	$18,755	141	$24,662
Cuba	152	18,349	248	27,899
Mexico	79	10,815	83	16,696
Panama	19	2,655	52	6,981
Other	90	11,857	169	29,107
	472	62,431	693	105,345
South America:				
Argentina	1,243	129,705	599	57,845
Brazil	2,439	243,303	1,538	154,135
Chile	494	56,284	989	112,220
Colombia	87	11,906	93	13,481
Ecuador	18	2,392	33	4,465
Peru	78	7,308	88	8,693
Uruguay	384	35,540	448	43,248
Other	91	9,181	64	7,318
	4,834	495,619	3.852	401,405
Europe:				
Belgium	861	74,549	896	92,085
Denmark	3,673	321,700	4,322	419,031
France	4,628	397,123	2,202	205,009
Germany	23,552	2,063,281	9,745	945,460
Italy	336	29,440	103	9,700
Netherlands	5,088	445,294	1,522	149,812
Sweden	5,316	463,050	7,255	708,255
United Kingdom	43,428	3,817,353	23,732	2,295,238
Other	279	25,418	872	84,945
	87,161	7,637,208	50,649	4.909,535
Asia:				
China	2,131	190,306	813	78,439
Japan	21,216	1,927,144	16,416	1,594,706
Philippine Islands	210	22,118	111	14,417
Other	245	24,296	715	74,154
	23,802	2,163,864	18,055	1,761,716
Africa	(1)	57	2	215
Oceania, French	(1)	42	(1)	121
	116,269	10,359,221	73,251	7,178,337

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[1] Less than 1 ton.

The following table shows the exports of lead from the United States from 1920 to 1929. Of the lead exported with benefit of drawback in 1929 miscellaneous lead manufactures (principally lead foil) accounted for 55.1 per cent, white lead in oil 25.1 per cent, red lead and litharge 9.9 per cent, babbitt 2.7 per cent, lead-covered cable 2.0 per cent, type metal 1.8 per cent, shot shells 1.6 per cent, and others 1.8 per cent.

Refined lead exported from the United States, 1920–1929

Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of drawback (short tons)	Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of drawback (short tons)
	Short tons	Value			Short tons	Value	
1920	20,093	$3,032,758	6,175	1925	103,519	$15,695,331	11,699
1921	26,624	2,462,033	9,369	1926	71,936	9,505,664	17,955
1922	38,178	3,781,965	5,677	1927	125,267	12,817,264	12,004
1923	50,735	5,455,743	12,526	1928	116,269	10,359,221	13,224
1924	82,090	10,396,766	15,275	1929	73,251	7,178,337	13,086

CONSUMPTION

REFINED PRIMARY PIG LEAD AVAILABLE FOR DOMESTIC CONSUMPTION

The manufacturing industry of the United States consumes lead in four main forms; namely, refined primary pig lead, primary antimonial lead, primary lead in the form of ore, and secondary lead. The following table shows the refined primary pig lead available for consumption from 1924 to 1929.

Refined primary pig lead available for consumption in the United States, 1924–1929, in short tons

	1924	1925	1926	1927	1928	1929
Supply:						
Stock in bonded warehouse Jan. 1	2,617	5,045	8,162	10,711	9,464	4,139
Imports of pigs, bars, and old [1]	12,247	7,021	11,152	2,467	662	1,658
Production	690,493	766,969	798,941	796,530	781,071	774,633
	705,357	779,035	818,255	809,708	791,197	780,430
Withdrawn:						
Exports—						
Pig lead	82,090	103,519	71,936	125,267	116,269	73,251
In manufactures, with benefit of drawback	15,275	11,699	17,955	12,004	13,224	13,086
Stock in bonded warehouse Dec. 31	5,045	8,162	10,711	9,464	4,139	1,328
	102,410	123,380	100,602	146,735	133,632	87,665
Supply available for consumption	602,947	655,655	717,653	662,973	657,565	692,765

[1] Includes 622 tons of "old, reclaimed, and scrap" in 1925 and 1,135 tons in 1926. Corresponding figures for other years not separately recorded.

The foregoing table is intended to include only primary lead or lead smelted directly from ore. There are, however, some small discrepancies which should be pointed out. Many primary lead smelters produce from secondary materials some lead that is inseparable from the primary lead in the final product. Exports of lead as reported above may therefore contain some secondary lead. There are also some inaccuracies in the statistics of imports, exports, and warehouse transactions. Nevertheless, on the basis of the data available, the table gives approximately the quantity of new refined lead available to American industry each year. As the table does not consider fluctuations in producers' and consumers' stocks, it indicates the trend of consumption only in a general way.

CONSUMPTION BY USES

The quantity of lead in all forms consumed by American industry is estimated each year by the American Bureau of Metal Statistics. The following table is quoted in full from the 1929 yearbook of that bureau.

Lead consumed in the United States,[1] 1921–1929, in short tons

Purpose	1921	1922	1923	1924	1925	1926	1927	1928	1929
White lead [2]	136,000	156,000	130,000	150,000	131,000	120,000	126,000	123,000	118,000
Red lead and litharge [3]	23,500	30,000	46,000	34,000	42,000	36,000	38,000	31,000	30,000
Storage batteries [4]	87,000	130,000	143,000	170,000	180,000	190,000	175,000	220,000	210,000
Cable covering [4]	67,000	93,000	131,000	138,000	156,000	185,000	161,000	180,000	206,000
Building [5]	48,000	71,000	75,000	83,100	88,400	93,700	88,000	96,000	96,000
Automobiles [5]	4,600	7,200	10,400	10,700	12,800	16,700	12,000	17,000	18,000
Locomotives [5]	1,000	850	2,100	1,100	750	1,000	650	500	800
Railway cars [5]	1,800	2,500	6,000	4,500	4,450	3,800	2,700	2,000	3,500
Shipbuilding [5]	850	100	.100	200	100	100	200	100	100
Ammunition [4]	26,500	38,000	40,000	27,000	31,500	32,000	34,000	39,600	41,100
Terneplate [4]	3,000	4.700	4,600	4,050	4,500	4,100	3,900	4,400	4,200
Foil [4]	23,800	26,800	33,300	35,000	32,500	35,000	30,000	35,000	30,000
Bearing metal [6]	21,000	26,000	28,000	32,000	34,000	36,000	31,000	32,000	33,000
Solder [7]	12,000	20,000	30,000	30,000	35,000	37,000	35,000	37,000	37,000
Type metal [7]	7,500	9,500	12,000	13,000	15,000	16,000	16,000	17,000	18,000
Calking [7]	20,000	20,000	25,000	26,500	30,000	32,000	30.000	32,000	31,500
Castings [7]	12,000	15,000	15,000	15,000	18,000	18,000	17,000	18,000	18,000
Other uses [8]	25,000	32,500	36,500	38,000	40,500	44,500	40,500	46,000	50,000
Total	520,550	683,150	768,000	812,150	856,500	900,900	840,950	930,600	945,200

[1] Source: American Bureau of Metal Statistics. These estimates are for the total consumption of lead, irrespective of whether its origin be primary or secondary. Antimonial lead is included and the manufacture of lead for export under drawback provisions is included.

[2] From data of sales reported by U. S. Bureau of Mines up to 1929. The 1929 figure has been determined by an improved method.

[3] Exclusive of oxides for storage batteries; based on data of sales reported by U. S. Bureau of Mines.

[4] Based on reports from a large proportion of manufacturers in each industry.

[5] Based upon estimates of manufacture and the quantity of lead used per unit of manufacture. Under the head of building is included the lead used in chemical construction.

[6] Based on the estimated consumption of lead for this purpose by the railways.

[7] Estimates of persons engaged in the trades.

[8] Conjectural.

According to the foregoing table the lead consumed in the United States in 1929 amounted to 945,200 tons, which surpassed all previous records. It exceeded 1928, the previous peak, by 2 per cent and 1927 by 12 per cent. In the following table the individual uses of lead have been arranged according to their percentage relation to the total lead consumed in 1929.

Percentage of total lead consumed in the United States, 1925–1929, by uses

Use	1925	1926	1927	1928	1929
Storage batteries	21.02	21.09	20.81	23.64	22.22
Cable coverings	18.21	20.53	19.15	19.34	21.79
White lead	15.29	13.32	14.98	13.22	12.48
Building	10.32	10.40	10.46	10.32	10.16
Ammunition	3.68	3.55	4.04	4.26	4.35
Solder	4.09	4.11	4.16	3.98	3.92
Bearing metal	3.97	4.00	3.69	3.44	3.49
Calking	3.50	3.55	3.57	3.44	3.33
Litharge and red lead	4.90	4.00	4.52	3.33	3.17
Foil	3.80	3.89	3.57	3.76	3.17
Castings	2.10	2.00	2.02	1.93	1.91
Type metal	1.75	1.78	1.90	1.83	1.91
Automobiles	1.49	1.85	1.43	1.83	1.91
Terneplate	.53	.45	.46	.47	.44
Railway cars	.52	.42	.32	.21	.37
Locomotives	.09	.11	.08	.05	.08
Shipbuilding	.01	.01	.02	.01	.01
Miscellaneous	4.73	4.94	4.82	4.94	5.29

For several years storage batteries have been the largest consumer of lead, having taken first place from white lead in 1923. Storage batteries are used chiefly in motor vehicles, yet notwithstanding a 23 per cent increase in the number of passenger cars and trucks manufactured in 1929 there was a decrease of 5 per cent in the quantity of lead used in storage batteries. The decrease was probably due in part to the larger percentage of light-weight cars manufactured in 1929 which operate with the smaller-size storage batteries. The American Bureau of Metal Statistics has estimated the production of automobile storage batteries at 16,000,000 in 1929 and 14,608,000 in 1928. Exports of storage batteries have grown steadily from a total of about 207,000 in 1925 to 353,000 in 1929, an increase of 70 per cent. The expansion of the automobile industry and export trade has more than offset the decreased use of storage batteries in radios which resulted from the introduction of "socket power" sets. The American Bureau of Metal Statistics has estimated that about 170,000 radio storage batteries were manufactured in 1929, as compared to 400,000 in 1928.

The second largest use of lead is as a protective coating for copper-wire cables used chiefly in telephone and underground transmission lines. The quantity of lead so used in 1929 exceeded all previous records, being 14 per cent greater than in 1928 and 11 per cent greater than in 1926, the previous peak. This use appears to be sure to increase. General expansion of the use of electrical power, such as the large electrification programs announced by some of the railway companies and the development of the Boulder Dam and other great power projects, will require large amounts of lead-covered cable. Increasing civic consciousness will undoubtedly result in placing many of the present unsightly overhead telephone and transmission lines underground, as has been the custom in Washington, D. C., for many years. Research work now in progress to determine the causes and remedies of certain defects in lead-covered cable that have limited its use in some industries should yield profitable results in expanding the market for lead-covered cable.

The manufacture of white lead is the third largest use of lead but one that appears to be on the decline. Prior to 1923 this industry was the largest consumer of lead and in 1922 took 156,000 tons of lead, or 23 per cent of the total estimated lead consumption. In 1929 only 118,000 tons (12.5 per cent of the total) was so used. The declining use of white lead is due to the substitution in paints of the cheaper pigments, principally lithopone and zinc oxide, and to the increased use of nitrocellulose paints in which white lead is seldom used on account of its chemical instability in contact with nitrocellulose products.

F. E. Wormser, secretary of the Lead Industries Association, has summarized developments in the uses of lead as follows: [12]

> A lead-calcium alloy which is finding wide use as cable sheathing has recently been developed. The addition of a very small amount of calcium to lead gives an alloy of high-fatigue strength which is resistant to failure from reverse stresses such as are often encountered in cables due to expansion and contraction.
>
> Lead linings are now being extensively used in the chemical industries, principally because of developments which have produced better products. The secrets of the various processes of manufacturers making lead-lined equipment are usually carefully guarded, but the fact remains that the product has been im-

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[12] Wormser, F. E., Lead: Metal Ind., vol. 28, January, 1930, p. 7.

proved. Could production costs be lowered, these products would find even a wider field of application. Large amounts of antimonial-lead sheet are used as tank linings in the chromium-plating industry, and it has been found that if these tanks are put into use immediately or if they are given anodic treatment at regular weekly intervals the life of the lining can be extended.

Lead-coated copper is finding growing favor for architectural purposes such as roofing, leaders, and gutters. It has the advantage of the strength and durability of copper plus the protection and durability of lead. Moreover, it furnishes a pleasing gray color, one which will not discolor, and is less expensive than antimonial or soft lead. This gives it a wide field of application on moderate-priced dwellings where lead is considered too expensive. Here it is interesting to note that results of tests on the corrosion of metals by city air, conducted in England and reported by J. Newton Friend, place antimonial lead at the top, followed by the highest grade of tin and then soft lead. Other metals, common tin, stainless steel, aluminum, copper, and so on, follow.

The Bureau of Standards is doing considerable research work on lead-bearing metals at the request of the Assistant Secretary of War with the idea of replacing tin-base bearings with lead base for the purpose of conserving tin. E. J. Hall, of the Hall-Scott Motor Car Co., reports that they have found that a bearing composed of 25 per cent lead and 75 per cent copper, having no lining or backing but a uniform structure throughout the shell, will give from 100,000 to 150,000 miles of intercity motor-coach service without attention.

The use of a baked red-lead priming coat under asphaltic or bituminous protective coatings on underground pipe lines has only received general attention in the last six months, although such a coat has been successfully used in isolated instances for several years. This red-lead coat has been entered in the tests of coating materials being conducted by the American Gas Association and the Bureau of Standards and should give a good account of itself judging by past performances. This may open another large market for red lead.

PRICES

The two major markets for lead in the United States are at New York and St. Louis, and a large part of the lead produced in the United States is sold at prices based on the quotations in these two markets. The New York quotations are influenced to some extent by the lower prices usually prevailing on the London market, so that the New York price seldom exceeds the St. Louis price by as much as the freight differential, 0.35 cent a pound. The following tables show the average monthly quoted prices of lead at St. Louis, New York, and London for 1927, 1928, and 1929 and the average yearly prices from 1910 to 1929, inclusive.

Average monthly quoted prices of lead at St. Louis, New York, and London, 1927–1929, in cents per pound [1]

Month	1927			1928			1929		
	St. Louis	New York	London	St. Louis	New York	London	St. Louis	New York	London
January	7.41	7.58	5.95	6.29	6.50	4.74	6.50	6.65	4.79
February	7.29	7.48	5.92	6.08	6.34	4.41	6.73	6.86	5.01
March	7.34	7.61	6.03	5.82	6.02	4.34	7.38	7.50	5.50
April	6.84	7.11	5.76	6.00	6.11	4.42	7.03	7.20	5.37
May	6.27	6.60	5.43	6.02	6.13	4.46	6.77	7.00	5.19
June	6.16	6.43	5.30	6.16	6.30	4.57	6.80	7.00	5.13
July	6.13	6.36	5.09	6.05	6.22	4.47	6.61	6.80	4.94
August	6.39	6.68	5.02	6.05	6.25	4.68	6.55	6.75	5.02
September	6.05	6.31	4.66	6.29	6.45	4.77	6.69	6.89	5.10
October	6.01	6.26	4.45	6.32	6.50	4.78	6.67	6.87	5.05
November	6.04	6.28	4.55	6.23	6.39	4.60	6.13	6.29	4.71
December	6.33	6.51	4.83	6.34	6.50	4.62	6.10	6.25	4.68

[1] St. Louis: Metal Statistics, 1930, p. 389. Average daily quotations of soft Missouri lead, f. o. b. St. Louis (open market), as reported daily in the American Metal Market.

New York: American Metal Market, daily issues. Pig lead, New York (outside market) prompt shipment from west.

London: Metal Statistics, 1930, p. 393. Average price of foreign lead. Price per long ton, as published in Metal Statistics, converted to cents per pound at average exchange rate reported by the Federal Reserve Board.

Average yearly prices of lead at St. Louis, New York, and London, 1910–1929

Year	St. Louis[1] (per pound)	New York[2] (per pound)	London[3]		New York excess (+) or London excess (−) (per pound)[4]
			Per long ton	Per pound	
	Cents	*Cents*		*Cents*	*Cents*
1910	4. 33	4. 49	£12. 950	2. 81	+1. 68
1911	4. 31	4. 46	13. 463	2. 92	+1. 54
1912	4. 38	4. 48	17. 792	3. 87	+. 61
1913	4. 26	4. 40	18. 308	3. 98	+. 42
1914	3. 74	3. 87	18. 688	4. 09	−. 22
1915	4. 57	4. 67	22. 883	4. 85	−. 18
1916	6. 80	6. 83	30. 975	6. 58	+. 25
1917	8. 92	8. 71	30. 000	6. 37	+2. 34
1918	7. 25	7. 46	30. 133	6. 40	+1. 06
1919	5. 55	5. 81	28. 196	5. 57	+. 24
1920	7. 93	8. 08	38. 229	6. 25	+1. 83
1921	4. 39	4. 55	22. 725	3. 90	+. 65
1922	5. 52	5. 71	23. 742	4. 69	+1. 02
1923	7. 35	7. 25	26. 817	5. 48	+1. 77
1924	8. 10	8. 08	33. 696	6. 64	+1. 44
1925	8. 92	9. 02	35. 863	7. 73	+1. 29
1926	8. 25	8. 42	31. 075	6. 74	+1. 68
1927	6. 52	6. 75	24. 192	5. 25	+1. 50
1928	6. 14	6. 31	21. 058	4. 58	+1. 73
1929	6. 66	6. 83	23. 246	5. 04	+1. 79

[1] Compiled from daily quotations in open market at St. Louis, as published in Metal Statistics, 1930, p. 387.

[2] Average prices based on quotations of American Smelting & Refining Co., as published in Metal Statistics, 1930, p. 381.

[3] Prices of foreign lead in London, as published in Metal Statistics, 1930, p. 393, converted to cents per pound on basis of average exchange rates published in the reports of the Federal Reserve Board.

[4] Import duties on refined pig lead have been as follows: Aug. 6, 1909, to Oct. 3, 1913—2⅛ cents per pound. Oct. 4, 1913, to Sept. 21, 1922—25 per centum ad valorem; average tariff collected—1¹⁄₁₀ cents per pound. Sept. 22, 1922, to date (1929)—2⅛ cents per pound.

To facilitate the settlement of its buying and selling contracts for lead the American Smelting & Refining Co., which controls a large part of the United States lead production, at frequent intervals publishes an official contract price based on the New York market. The following are the company's quotations for 50-ton lots, f. o. b. New York, in 1928 and 1929, in cents per pound:

1928	
Feb. 10	6. 35
Feb. 20	6. 25
Feb. 27	6. 15
Mar. 1	6. 00
Apr. 2	6. 10
May 25	6. 20
May 29	6. 30
July 9	6. 20
Aug. 23	6. 30
Aug. 27	6. 40
Sept. 17	6. 50
Nov. 9	6. 35
Dec. 3	6. 50
1929	
Jan. 2	6. 65
Feb. 6	6. 75

1929	
Feb. 11	6. 85
Feb. 19	6. 95
Feb. 27	7. 10
Mar. 6	7. 25
Mar. 19	7. 50
Mar. 20	7. 75
Apr. 4	7. 50
Apr. 8	7. 25
Apr. 10	7. 15
Apr. 15	7. 00
July 5	6. 90
July 10	6. 75
Sept. 5	6. 90
Oct. 29	6. 75
Oct. 31	6. 50
Nov. 6	6. 35
Nov. 7	6. 25

The gradual upward trend in the price of lead evident in 1928 continued in the early part of 1929. The New York quotation on January 2 and the average for that month was 6.65 cents per pound, a sharp increase from 6.50 cents on December 31, 1928. During February there was a further increase to an average of 6.86 cents. The threatened curtailment of supplies from Mexico, due to the revolution, sent the price to 7.80 cents toward the latter part of March, a high for the year, but following the collapse of the revolution the price quickly declined to 7 cents by April 15. Meanwhile rising prices had stimulated production, and when domestic consumption declined sharply in May and June stocks increased rapidly and the price of lead decreased to an average of 6.75 cents in August. In September and October the price increased slightly as a result of increased demand, but in November and December the price dropped off sharply following the stock-market crash. The New York quotation was 6.25 cents on December 31, 1929.

The average New York price for 1929 was 6.83 cents—8 per cent over the 1927 average and 24 per cent under the record 1925 price. The New York market averaged 0.17 cent per pound over the St. Louis market in 1928, as compared with 0.17 cent in 1928 and 0.23 cent in 1927.

The average price, including domestic and foreign sales, received by lead producers in the United States in 1929, according to reports of producers to the Bureau of Mines, was 6.3 cents a pound; in 1928 it was 5.8 cents.

The London quotation reached the high monthly average in March (equivalent to 5.5 cents per pound), declined to approximately 5 cents during July, August, September, and October, then declined further to 4.68 cents in December. The yearly average was 10 per cent greater in 1929 than in 1928; it was 1.79 cents per pound under the New York price in 1929, as compared to 1.73 cents in 1928.

GOLD, SILVER, AND LEAD IN SOUTH DAKOTA[1] [2]

(MINE REPORT)

By Chas. W. Henderson

SUMMARY

Metal mining in South Dakota is confined to the three southwestern counties—Custer, Lawrence, and Pennington—in what is known as the Black Hills. The Homestake gold mine, at Lead, Lawrence County, has been producing almost continuously since 1875 and is now the largest producing gold mine in the United States. Ore from this mine to the company's mills amounted to 1,437,935 tons in 1929, an increase of 20,986 tons over 1928, but the revenue from the sale of gold-silver bullion bars amounted to $6,517,837.95 in 1929—$48,946.74 less than in 1928. The only other producing mine in South Dakota in 1929 was a lode mine in the Keystone district, Pennington County. The following table shows the number of producing mines, tons of ore produced, and recovered content of metals in South Dakota from 1920 to 1929.

Mine production of gold, silver, and lead in South Dakota, 1920–1929, in terms of recovered metals [a]

Year	Mines producing			Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)		Lead		Total value
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value	Pounds	Value	
1920	3	4	7	1,356,189	226,224.23	$4,676,470	90,795	$98,966	12,812	$1,025	$4,776,461
1921	3	6	9	1,725,685	319,524.95	6,605,167	112,464	112,464	4,000	180	6,717,811
1922	3	3	6	1,751,454	315,297.99	6,517,788	118,760	118,760	--------	-------	6,636,548
1923	5	-------	5	1,665,439	309,905.05	6,406,306	95,844	78,592	--------	-------	6,484,898
1924	4	-------	4	1,674,720	295,930.24	6,117,421	86,548	57,987	--------	-------	6,175,408
1925	3	-------	3	1,590,079	289,747.10	5,989,604	96,133	66,716	--------	-------	6,056,320
1926	2	2	4	1,415,785	279,528.93	5,778,376	82,186	51,284	--------	-------	5,829,660
1927	2	2	4	1,376,583	322,031.74	6,656,987	96,171	54,529	138,000	8,694	6,720,210
1928	5	4	9	1,422,233	317,378.94	6,560,805	90,547	52,970	74,000	4,292	6,618,067
1929	2	-------	2	1,463,159	316,836.85	6,549,599	85,182	45,402	--------	------	6,595,001

[a] For total production of gold and silver in South Dakota, by years, see Mineral Resources, 1913, pt. 1, p. 42, and Mineral Resources, 1922, pt. 1, p. 194.

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[1] Work on manuscript completed February, 1931.

[2] For information on the geology of the metal resources of South Dakota see Paige, Sidney, U. S. Geol. Survey Geol. Atlas, Central Black Hills Folio 219, 1925.

Gold and silver produced at placer mines in South Dakota, 1920–1929

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1920	27.91	$577	5	$5	$582
1921	89.44	1,849	7	7	1,856
1922	87.99	1,819	7	7	1,826
1923–1925	----------	----------	----------	----------	----------
1926	6.43	133	----------	----------	133
1927	14.46	299	----------	----------	299
1928	11.13	230	----------	----------	230
1929	----------	----------	----------	----------	----------

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1920 to 1922 is New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1920	$1.09	$0.184	$0.080	$0.081	1925	$0.694	$0.142	$0.087	$0.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064
1923	.82	.147	.070	.068	1928	.585	.144	.058	.061
1924	.67	.131	.080	.065	1929	.533	.176	.063	.066

MINING AND METALLURGIC INDUSTRY

Production at the Homestake mine was continuous during 1929. A review of the Homestake and other operations is noted under the review by counties.

Gold and silver bullion produced at mills in South Dakota by amalgamation, 1920–1929

Year	Ore treated	Gold in bullion	Silver in bullion	Quicksilver used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
1920	1,274,944	148,018.30	42,863	8,660
1921	1,620,588	214,003.69	60,604	22,500
1922	1,663,525	218,247.50	58,806	7,500
1923	1,652,337	216,907.61	60,624	10,725
1924	1,674,720	203,174.24	52,920	7,625
1925	1,589,711	195,865.49	49,812	7,500
1926	1,415,785	187,119.66	47,284	5,625
1927	1,371,583	208,952.00	52,480	14,188
1928	1,417,029	211,921.22	51,649	10,550
1929	1,437,935	210,869.03	51,676	9,225

Gold and silver bullion produced at mills in South Dakota by cyanidation, 1920–1929

Year	Material treated			Gold in bullion	Silver in bullion	Sodium cyanide used [1]
	Crude ore	Sands and slimes	Total			
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*
1920	81, 135	1, 245, 419	1, 326, 554	78, 062. 93	44, 456	339, 122
1921	49, 047	1, 620, 588	1, 669, 635	105, 360. 12	50, 811	395, 228
1922	87, 929	1, 620, 699	1, 708, 628	96, 962. 50	59, 947	387, 683
1923	13, 087	1, 626, 234	1, 639, 321	92, 960. 74	35, 135	361, 900
1924		1, 647, 344	1, 647, 344	92, 756. 00	33, 628	361, 650
1925		1, 567, 555	1, 567, 555	92, 528. 61	32, 005	347, 242
1926		1, 402, 472	1, 402, 472	92, 402. 84	34, 902	299, 672
1927		1, 353, 298	1, 353, 298	113, 058. 32	41, 005	312, 626
1928	5, 109	1, 371, 096	1, 376, 205	105, 444. 56	37, 421	335, 675
1929	25, 224	1, 358, 870	1, 384, 094	105, 967. 82	33, 506	[2] 353, 859

[1] In terms of 96 to 98 per cent strength.

[2] Actually 642,999 pounds of cyanamid (48 per cent) and 32,359 pounds of 96 to 98 per cent strength; cyanamid reduced to equivalent of 96 to 98 per cent strength to conform with earlier use of figures for high strength NaCN and KCN.

Mine production of metals from South Dakota crude ore shipped to smelters, 1920–1929, in terms of recovered metals

Year	Crude ore	Gold	Silver	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
1920	110	115. 09	3, 471	12, 812
1921	157	71. 70	1, 042	4, 000
1922				
1923	15	36. 70	85	
1924				
1925	368	1, 353. 00	14, 316	
1926–27				
1928	95	2. 03	1, 477	74, 000
1929				

REVIEW BY COUNTIES

CUSTER COUNTY

Mine production of gold, silver, and lead in Custer County, S. Dak., 1920–1929, in terms of recovered metals

Year	Mines producing		Ore	Gold (lode and placer)	Silver (lode and placer)	Lead	Total value
	Lode	Placer					
			Short tons		*Fine ounces*	*Pounds*	
1920							
1921		3		$582	1		$583
1922–1925							
1926		1		30			30
1927	1		5, 000	144	2, 686	138, 000	10, 361
1928	1		95	42	1, 477	74, 000	5, 198
1929							

The Spokane property, 17 miles from Custer and 6 miles from Keystone, a producer of gold, silver, and lead in 1927 and for a few months in 1928 remained idle in 1929. A nearly vertical shaft 325 feet deep, with levels at 100, 200, and 300 feet, opens the property. The mill is a 100-ton plant equipped with 1 crusher, 1 set of rolls, 1 Marcy ball mill, 1 Dorr drag classifier, 1 Wilfley pilot table. 1

eight-cell "Minerals Separation" flotation machine for lead, 1 ten-cell "Minerals Separation" flotation machine for zinc, 2 Dorr thickeners, and 1 United disk filter.

LAWRENCE COUNTY

Mine production of gold, silver, and lead in Lawrence County, S. Dak., 1920–1929, in terms of recovered metals

Year	Mines producing	Ore	Gold (lode and placer)	Silver (lode and placer)	Lead	Total value
		Short tons		*Fine ounces*	*Pounds*	
1920	7	1, 356, 189	$4, 676, 470	90, 795	12, 812	$4, 776, 461
1921	3	1, 725, 685	6, 603, 318	112, 457	4, 000	6, 715, 955
1922	4	1, 751, 414	6, 515, 969	118, 753	----------	6, 634, 722
1923	4	1, 665, 437	6, 406, 206	95, 844	----------	6, 484, 798
1924	1	1, 670, 300	6, 091, 100	86, 354	----------	6, 148, 957
1925	2	1, 590, 069	5, 988, 570	96, 133	----------	6, 055, 286
1926	2	1, 415, 775	5, 777, 545	82, 186	----------	5, 828, 829
1927	2	1, 371, 583	6, 656, 738	93, 485	----------	6, 709, 744
1928	1	1, 416, 949	6, 533, 894	88, 829	----------	6, 585, 859
1929	1	1, 437, 935	6, 491, 184	84, 987	----------	6, 536, 482

HOMESTAKE MINE[3]

The total value of the product of the Homestake Mining Co. from 1875 to 1929, inclusive, is $226,121,128.19, and the amount paid in dividends is $55,859,404.29.

Ore milled, receipts, and dividends, Homestake mine, 1920–1929

Year	Ore milled	Receipts for bullion product		Dividends
		Total	Per ton	
	Short tons			
1920	1, 274, 944	$4, 410, 193. 73	$3. 4591	----------
1921	1, 620, 588	6, 299, 780. 38	3. 8873	$502, 320
1922	1, 663, 485	6, 285, 317. 56	3. 7784	879, 060
1923	1, 652, 337	6, 400, 078. 42	3. 8733	1, 506, 960
1924	1, 670, 300	6, 126, 349. 99	3. 6678	1, 758, 120
1925	1, 589, 701	5, 999, 073. 50	3. 7737	1, 758, 120
1926	1, 415, 775	5, 811, 943. 90	4. 1051	1, 758, 120
1927	1, 371, 583	6, 679, 802. 31	4. 8701	1, 758, 120
1928	1, 416, 949	6, 566, 784. 69	4. 6345	1, 758, 120
1929	1, 437, 935	6, 517, 837. 95	4. 5328	1, 758, 120

The annual report[4] of the general manager of the Homestake Mining Co. for the year ended December 31, 1929, says:

> At the close of another year in the life of the Homestake mine, I am pleased to report that operations have been continuous and satisfactory.
>
> Following is a condensed report by the mine engineer: Development drifts driven 14,964 feet; development raises driven 8,768 feet.
>
> There are 686,495 tons of ore broken down and remaining in the stopes.
>
> There are 15,176,740 tons of ore blocked out and remaining in the mine.
>
> Development of the 2,600 foot level is progressing satisfactorily with encouraging results.

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[3] For description of geology see Paige, Sidney, The Geology of the Homestake Mine: Econ. Geol., vol. 18, 1923, pp. 205–237; Geology of the Region Around Lead, S. Dak., and Its Bearing on the Homestake Ore Body: U. S. Geol. Survey Bull. 765, 1924, 56 pp.; Central Black Hills, S. Dak.: U. S. Geol. Survey Geol. Atlas, Folio 219, 1925. Hosted, J. O., and Wright, L. B., Geology of the Homestake Ore Bodies and the Lead Area, South Dakota: Eng. and Min. Jour.-Press, vol. 115, May 5, 1923, pp. 793–799; May 12, 1923, pp. 836–843.

[4] See also Engineering and Mining Journal (extracts from report): Vol. 129, No. 6, Mar. 24, 1930, pp. 318 and 323.

A 1,000 K. W. turbine generator has been installed at the coal mine. No additions of importance have been made to the Lead plant equipment.

Statement of operations of the Homestake mine, Lead, S. Dak., for the year ended December 31, 1929

Operating revenue:		
Bullion—		
Proceeds of bars 7221–7463	$6, 517, 837. 95	
During the year 1,437,935 tons of ore were milled, realizing an average of $4.53278 per ton.		
Golden Gate timber operation	29, 736. 34	
Interest and rents	152, 857. 18	
		$6, 700, 431. 47
Operating expenses:		
Mining, hoisting, and primary crushing	2, 637, 149. 45	
Tramming	46, 767. 30	
Milling	668, 475. 28	
Express on bullion	7, 183. 15	
Wyodak coal operation	9, 692. 97	
Canadian exploration	19, 565. 16	
Employees' welfare	163, 482. 30	
Taxes	453, 151. 63	
Insurance	23, 339. 12	
Salaries, office, legal, and general expenses	198, 429. 45	
		4, 227, 235. 81
Income		2, 473, 195. 66
Charges against income—Reserved for depreciation and depletion		1, 429, 125. 21
Net income		1, 044, 070. 45
Dividends for the year:		
Paid from earnings		1, 119, 060. 11
Paid from depletion reserve		639, 059. 89
Total for year		1, 758, 120. 00

The Homestake mine is opened by three main shafts, the deepest of which is 2,600 feet, and by about 69 miles of adits, drifts, and crosscuts. The mining methods used at the Homestake were last described by Ross and Wayland in 1926.[5]

The milling plants operated by the Homestake Mining Co. in 1929 consisted of three amalgamation mills and three cyanidation mills. The amalgamation mills were the South mill, at Lead, built in 1922; the Amicus mill, at Lead, originally built in 1879; and the Pocahontas mill, at Terraville, built in 1881. The cyanidation mills were the Sand plant No. 1, at Lead, built in 1901; the Sand plant No. 2, at Blacktail, built in 1902; and the Slime plant, at Deadwood, built in 1906. The sands from the amalgamation mill at Terraville go to Sand plant No. 2, and the sands from the amalgamation mills at Lead go to Sand plant No. 1; the slimes from all three amalgamation mills go to the Slime plant.

The capacity and equipment of these mills are as follows: South mill—1,960 tons per day, 120 gravity stamps (1,550 pounds each), 2,860 square feet of amalgamating plates, eight 5 by 10 foot rod mills, three 5 by 14 foot tube mills, one 8 by 6 foot tube mill, 10 Dorr drag classifiers, and 13 cone classifiers; Amicus mill—1,309 tons per day,

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[5] Ross, A. J. M., and Wayland, R. G., Mining Methods at the Homestake: Min. and Met., vol. 7, No. 229, January, 1926, p. 21. See also Wiggert, J.F., Electrification of a Large Gold Mine: General Elec. Rev., vol. 32, No. 9, September, 1929, pp. 477–489.

240 gravity stamps (1,000 pounds each), 3,780 square feet of amalgamating plates, three 5 by 14 foot tube mills, two 5 by 18 foot tube mills, 5 Dorr drag classifiers, and 12 cone classifiers; Pocahontas mill—670 tons per day, 160 gravity stamps (900 pounds each), and 2,592 square feet of amalgamating plates; Sand plant No. 1—1,744 tons per day, 26 special cone classifiers, 18 special hydraulic classifiers, 19 leaching tanks (each 45 feet in diameter), 11 Dorr thickening tanks, 21 cone-bottom thickening tanks, and 2 Merrill precipitation presses; Sand plant No. 2—377 tons per day, 11 special cone classifiers, 6 special hydraulic classifiers, 4 leaching tanks (each 54 feet in diameter), 14 cone-bottom thickening tanks, and 1 Merrill precipitation press; and Slime plant—1,601 tons per day, 31 Merrill frame filter presses, and 2 Merrill precipitation presses. A summary of the foregoing shows that in 1929 the amalgamation plants had a total capacity of 3,939 tons per day and the cyanidation plants, 3,722 tons per day.

The Bald Mountain Mining Co., which in 1928 bought the properties of the Trojan Mining Co. (an important producer in the Bald Mountain area until 1923), continued in 1929 the incline adit begun in 1928 to cut the Two Johns ore body beyond a fault. At the end of 1929, 1,200 feet of the anticipated 1800 adit had been driven. The "Trojan" cyanidation mill remained idle, with equipment the same as in 1923.

Small placers on Potato, Beaver, and Iron Creeks, near Tinton, Lawrence County, yielded very small quantities of placer gold (lots of from 50 cents to less than $20 each) which were not marketed until 1930.

PENNINGTON COUNTY

Mine production of gold and silver in Pennington County, S. Dak., 1920-1929, in terms of recovered metals

Year	Mines producing		Ore	Gold (lode and placer)	Silver (lode and placer)	Total value
	Lode	Placer				
			Short tons		*Fine ounces*	
1920	----------	----------	----------	----------	----------	----------
1921	----------	3	----------	$1,267	6	$1,273
1922	1	1	40	1,819	7	1,826
1923	1	----------	2	100	----------	100
1924	3	----------	4,420	26,321	194	26,451
1925	1	----------	10	1,034	----------	1,034
1926	1	----------	10	801	----------	801
1927	----------	1	----------	105	----------	105
1928	3	----------	5,189	26,869	241	27,010
1929	1	----------	25,224	58,415	195	58,519

In 1929 the Keystone Consolidated Mines Co. (Inc.) continued development and construction work begun August, 1927, at the old Columbia-Holy Terror-Keystone-Bullion-Lucky Boy group in the Keystone district, across the county line in Pennington County. Development in 1929 consisted of work on three levels of the Bullion mine and the driving of a drift 1,500 feet long from the Bullion to the Columbia mine. The 100-ton cyanidation mill was run almost continuously in 1929. The ore is pyrite and arsenopyrite with a gangue of calcite, siderite, quartz, and graphite. The vein is 18 to 25 feet thick, dips 87° to 89°, and is mined by shrinkage stoping.

GOLD, SILVER, AND COPPER IN WYOMING[1]

(MINE REPORT)

By Chas. W. Henderson

SUMMARY

In 1929 Wyoming metal mines (not including iron mines) produced gold, silver, and copper valued in terms of recovered metals at $1,766, compared with gold, silver, and copper valued at $1,083 in 1928. In 1929 two amalgamating mills in the Atlantic City district, Fremont County, produced gold-silver bullion; a 2-ton lot of copper-silver ore was shipped direct to the smelter from the Michigan prospect, in Muskrat Creek district, Goshen County; and a 26-ton lot of copper-silver ore was shipped direct to the smelter from the Blue Jay group, in the Kuny Hills district, near Wheatland, Platte County. The Sunrise iron mine, at Sunrise, continued to supply a large part of the raw iron ore treated at the iron and steel mill at Pueblo, Colo., but it yielded no copper ore in 1929.

Mine production of gold, silver, and copper in Wyoming, 1920–1929, in terms of recovered metals

Year	Ore (short tons)	Gold	Silver		Copper		Total value
			Fine ounces	Value	Pounds	Value	
1920	-----	-----	-----	-----	-----	-----	-----
1921	50	$62	111	$111	10,000	$1,290	$1,463
1922	24	1,207	57	57	4,296	580	1,844
1923	584	296	254	208	111,280	16,358	16,862
1924–1926	-----	-----	-----	-----	-----	-----	-----
1927	110	1,200	5	3	-----	-----	1,203
1928	129	677	53	31	2,604	375	1,083
1929	143	995	26	14	4,301	757	1,766

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1920 to 1922 is New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

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[1] Work on manuscript completed February, 1931.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1920	$1.09	$0.184	$0.080	$0.081	1925	$0.694	$0.142	$0.087	$0.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064
1923	.82	.147	.070	.068	1928	.585	.144	.058	.061
1924	.67	.131	.080	.065	1929	.533	.176	.063	.066

REVIEW BY COUNTIES AND DISTRICTS

ALBANY COUNTY

Centennial district.[2]—The Cliff property and 100-ton amalgamation-flotation mill, on the Middle Fork of Little Laramie River, were idle. Development work was done at the Utopia group, near Centennial. The concentration mill, built near Centennial to treat rock from the Queen claim on Centennial Mountain, was not operated.

Douglas Creek district (*Holmes, Foxpark*).—Assessment work was done at the Rambler group, at Holmes, once a producer of gold-silver-copper-platinum-palladium ore.[3] The last shipments from this mine were in 1923, when 55 tons of ore from the dump was settled for on a payment basis for contents of 8.56 ounces of gold, 104 ounces of silver, 6,717 pounds of copper, 4.39 ounces of platinum, and 23.99 ounces of palladium. Assessment and small development work was done at the Gold Crater lode claim, Independence lode claim, and Moore's Gulch placer and lode groups.

Tie Siding district.[4]—The Copper-Gold Mining & Milling Co. completed a concentration mill in August, 1928, at the Atlas group, near Tie Siding, but produced nothing in 1928 or 1929.

CARBON COUNTY

Encampment district.—Annual assessment work was done at several prospects in the Encampment district.

Seminoe district.—A total of 200 feet of development work was done in 1929 on the Penn-Seminoe-King group.

CONVERSE COUNTY

In 1929 only assessment work was done by the Miami Copper Co. In 1928 this company in developing the Miami group in section 10, T. 29 N., R. 75 W. of the sixth principal meridian, 25 miles from Douglas, sank the shaft from 238 to 280 feet. There are five drifts from the shaft, totaling about 500 feet. The property is equipped with a steam plant for power, compressor, hoist, electric generator for lighting, 180-gallon station pump, 50-gallon sinking pump, and air drills.

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[2] For map and description of properties see Hess, F. L., Platinum Near Centennial, Wyo.; Contributions to Economic Geology: U. S. Geol. Survey Bull. 780, 1926, pp. 127–135.

[3] See Kemp, J. F., Platinum in the Rambler Mine, Wyoming: Mineral Resources, 1902, pp. 244–250.

[4] For general geology and cross section see Darton, N. H., and Siebenthal, C. E., Geology and Mineral Resources of the Laramie Basin, Wyoming: U. S. Geol. Survey Bull. 364, Plates I and VIII, 1909.

FREMONT COUNTY

Atlantic City district.[5]—The Carissa mine, which had once been a producer but had been idle and kept unwatered for many years by its owners, was leased October 1, 1928, to the Midwest Mining Co., which purchased also the old Dexter stamp mill and moved it to the Carissa site in 1929. The mine is opened by a 384-foot shaft and 2,500 feet of drifts and crosscuts. The Hidden Hand mine and its 10-stamp mill, idle in 1928, produced amalgam gold bullion in 1929. The B. & H. Mining Co., which in 1928 built a 10-stamp amalgamation mill on the Ellen Mc group and milled 100 tons of gold ore, did only development work in 1929. The U. S. Mining & Milling Co. in 1929 installed a Diesel engine power plant and built an amalgamation-cyanidation mill on the McGrath or "1914"-Sullivan mine. Production began early in 1930.

GOSHEN COUNTY

Muskrat Creek district.—A 2-ton lot of silver-copper ore was shipped from the Michigan property to the Garfield (Utah) smelter.

PLATTE COUNTY

Kuny Hills district (*Wheatland*).—Development work was done for eight months on the Blue Jay group, near Wheatland, and a car of silver-copper ore was shipped to the Garfield (Utah) smelter.

Sunrise district.—The Colorado Fuel & Iron Co.'s Sunrise iron mine at Sunrise continued to supply iron ore to the company's iron and steel plant at Pueblo, Colo. No copper ore was shipped from this property in 1929.

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[5] For geology see Spencer, A. C., The Atlantic Gold District and the North Laramie Mountains, Fremont, Converse, and Albany Counties, Wyoming: U. S. Geol. Survey Bull. 626, 1916, 85 pp.

MANGANESE AND MANGANIFEROUS ORES[1]

By Lewis A. Smith[2]

STATISTICAL SUMMARY

Salient figures of the manganese industry in the United States, 1928 and 1929

	1928		1929	
	Long tons	Value	Long tons	Value
Domestic shipments:				
Total ore containing 35 per cent or more Mn	46,860	$1,214,853	60,379	$1,612,357
Metallurgical ore	31,430	593,561	47,597	1,036,199
Chemical ore	15,430	621,292	12,782	576,158
Number of producing mines:				
Total	38		37	
Metallurgical ore	35		34	
Chemical ore	3		3	
Imports:				
Manganese ore	427,708	5,395,949	664,269	8,450,818
Ferromanganese (manganese content)	48,844	4,899,374	56,969	6,126,056
In bonded warehouse Dec. 31:				
Manganese ore (manganese content)	114,497	4,049,731	114,092	4,196,242
Ferromanganese (manganese content)	5,040	612,150	10,969	1,253,429

INTRODUCTION

Domestic mines in 1929 shipped 60,379 long tons of high-grade manganese ore, as compared with 46,860 tons in 1928. Shipments of ferruginous manganese ore and manganiferous iron ore amounted to 1,188,258 long tons in 1929, compared with 1,175,982 tons in 1928; this increase is attributed to the manufacture of greater amounts of manganiferous pig iron and spiegeleisen. The production of spiegeleisen increased from 99,517 long tons in 1928 to 137,143 tons in 1929, whereas pig-iron production rose from 37,410,897 long tons to 41,761,488 tons. It is assumed that manganiferous pig-iron production increased also. Production of iron ores containing 2 to 5 per cent manganese increased from 1,277,000 long tons in 1928 to 1,612,000 tons in 1929, a gain of 335,000 tons.

Imports of manganese ore, including chemical ore, amounted to 664,269 long tons, an increase of 236,561 tons over 1928. The ores in stock in six bonded warehouses in the United States on December 31, 1929, contained 114,092 long tons of metallic manganese, practically the same amount as at the end of the previous year.

The ferromanganese production at domestic furnaces amounted to 339,205 long tons in 1929, containing about 269,000 tons of metallic manganese. This required 642,321 tons of foreign and domestic manganese ore averaging 47.96 per cent manganese, equivalent to 616,114 tons of 50 per cent ore, and, in addition, 47,492 tons of ferruginous manganese ore and miscellaneous manganese-bearing material, averaging 26.17 per cent manganese, equivalent to 24,856 tons of 50 per cent ore—a total of 689,813 tons of material averaging 46.46 per cent manganese, equivalent to 640,970 tons of 50 per cent ore. Ferromanganese imported for consumption amounted to 71,211 long tons in 1929, the equivalent of 144,816 tons of material averaging 46.46 per cent manganese, or 134,564 tons of 50 per cent ore. Thus the new supply of ferromanganese in the United States in 1929 was equivalent to 775,534 long tons of 50 per cent ore.

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[1] Work on manuscript completed October, 1930.

[2] The statistics on domestic output were prepared by H. W. Davis and the data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

The manganese content of ferromanganese in stock in bonded warehouses increased from 5,040 long tons on December 31, 1928, to 10,969 tons on December 31, 1929, a net increase of 5,929 tons.

The consumption of chemical manganese ore is estimated at 40,000 to 50,000 tons, making a total consumption of about 816,000 to 826,000 tons of 50 per cent manganese ore during 1929, a substantial increase over 1928.

The production of steel increased from 51,544,180 long tons in 1928 to 56,433,473 tons in 1929.

During 1929 an increased tonnage of ferruginous manganese ore and manganiferous iron ore was imported from Australia, Brazil, Spain, and Africa. This ore is desirable because its high metallic content and low silica and alumina content permit its mixture with high-silica, low-iron, high-manganese ores for the manufacture of ferromanganese. Such ores are also used in the manufacture of spiegeleisen and manganiferous pig iron.

In the United States the outstanding features in 1929 were: (*a*) The increased production of iron ores containing 2 to 5 per cent manganese. (*b*) The increased importation of ferruginous manganese and manganiferous iron ores. (*c*) The completion of the beneficiation plant of the Georgia Manganese & Iron Co. (*d*) The successful floating of rhodochrosite ore containing zinc and lead, with subsequent recovery of all three, at the Butte plant of the Anaconda Copper Mining Co. (*e*) The successful conclusion of stage 2 of the Bureau of Mines experiments on the manufacture of a slag containing 55 to 70 per cent of manganese oxide in the open-hearth furnace. The third and last stage will attempt to convert this high-manganese slag into ferromanganese. (*f*) The examination of deposits and estimation of reserves at Chamberlain, S. Dak., by the United States Geological Survey. (*g*) The near completion of several washing and beneficiation plants in Virginia and elsewhere for the concentration of low-grade ore.

The second annual convention of the American Manganese Producers Association took place in Washington, D. C., in September, 1929. The discussions were largely relative to the tariff bill, then under consideration in Congress.

In June, 1930, the new tariff went into effect. The most important change was the extension of the duty to include ores containing 10 to 30 per cent manganese which previously had been admitted free. There was no change in the ferromanganese schedules.

From an international standpoint the continued development of the Postmasburg and Bou Arfa fields in Africa and the rejuvenation of the Russian manganese industry were outstanding. Other interesting features include: (*a*) The increase in exports from Gold Coast in the face of active competition from Russian fields. (*b*) The increase in exports from India and the reported increase in stocks in India at the end of 1929. (*c*) The continued increase in imports into France. (*d*) The near completion of the harbor at Takoradi in Gold Coast. (*e*) The reopening of the New Ross field in Nova Scotia. (*f*) The decrease in Brazilian exports. (*g*) The favorable development of the manganese deposits in South Australia and Asia Minor. (*h*) The continued increase in world stocks as compared to consumption. (*i*) The sharp drop in prices during the latter half of the year, resulting from oversupply due principally to the large increase in exports from Russia, Gold Coast, and India.

Domestic manganese prices were affected somewhat by the general world depression. In general, world prices decreased from 1 to 3 cents per unit during the latter half of 1929.

During 1929 high-grade ore was divided into four general classes: Ore in which the tenor ranged from 35 to 45 per cent manganese; ore which contained 45 to 50 per cent manganese; ore with a tenor of over 50 per cent manganese (usually washed); and sinter which contained 56 to 59 per cent manganese. The average quoted price of foreign metallurgical ore per long ton, c. i. f. North Atlantic ports, for the year is given in detail under "Price of manganese ore."

UNITED STATES

PRODUCTION

The mines of the United States shipped 60,379 long tons of metallurgical and chemical manganese ore, valued at $1,612,357, in 1929, compared with 46,860 tons, valued at $1,214,853, in 1928, an increase of 28.85 per cent in quantity. Shipments of metallurgical ore in 1929 amounted to 47,597 tons, valued at $1,036,199, an increase in quantity of 51.44 per cent over 1928. Shipments of chemical ore amounted to 12,782 tons, valued at $576,158, a decrease in quantity of 17.16 per cent. Of the domestic output of chemical ore in 1929, Montana produced 96.9 per cent and Virginia 3.1 per cent, whereas in 1928 Montana produced 95 per cent and Virginia 5 per cent.

MANGANESE ORE

The total production of high-grade manganese ores during 1926, 1927, and 1928 averaged about 46,000 long tons, but in 1929 this average was exceeded by 14,000 tons. The increase for 1929 was due entirely to the increase in output of metallurgical ore from 26,530 tons in 1926 to 47,597 tons in 1929. The output of chemical ores has gradually decreased from 24,637 tons in 1924 to 12,782 tons in 1929.

Manganese alloys and ore produced in the United States and imported from principal foreign sources, 1920–1929, in long tons

Year	Steel (production)[1]	Ferromanganese		Spiegeleisen		Manganese ore				
		Shipments	Imports	Shipments	Imports	Shipments[2]	Total imports	Imports from—		
								Russia	India	Brazil
1920	42,132,934	276,594	59,254	103,672	5,234	94,420	[3] 599,764	18,762	71,238	421,523
1921	19,783,797	111,374	9,077	69,230	307	13,531	[3] 392,606	----------	113,730	262,468
1922	35,602,926	161,612	[4] 100,725	70,253	8,151	13,404	[4] 425,000	---------- [6] 1,642	[5] 24,250 [6] 298	[5] 234,598 [6] 40,595
1923	44,943,696	226,365	[4] 113,833	134,086	4,668	31,500	[4] 419,000	[7] 11,670	[7] 25,568	[7] 88,036
1924	37,931,939	232,821	[4] 56,588	76,179	7,433	56,515	[4] 505,000	[7] 41,097	[7] 54,566	[7] 54,938
1925	45,393,524	254,005	[4] 78,713	95,890	1,090	98,324	[4] 615,000	[7] 114,537	[7] 23,504	[7] 109,650
1926	48,293,763	330,070	[4] 59,710	82,982	8,783	46,258	[4] 738,000	[7] 122,345	[7] 30,596	[7] 130,698
1927	44,935,185	291,056	[4] 45,500	80,892	7,529	44,741	622,067	253,544	93,017	174,026
1928	51,544,180	310,122	[4] 61,055	116,911	5,260	46,860	427,708	159,842	83,600	142,300
1929	56,433,473	334,162	[4] 71,211	123,146	13,828	60,379	664,269	329,336	72,940	216,535

[1] According to American Iron and Steel Institute.

[2] Exclusive of small quantities of ore shipped for use in fluxing.

[3] Exclusive of 7,173 tons in 1920 and 8,748 tons in 1921 reported by Bureau of Foreign and Domestic Commerce as manganese ore. The value of this "ore" ranged from $46 to $292 a ton; consequently the Bureau of Mines believes that the figures represent imports of ferromanganese, spiegeleisen, manganese chemicals, and perhaps some chemical ore.

[4] From Sept. 22, 1922, to Dec. 31, 1926, the Bureau of Foreign and Domestic Commerce reported only the manganese content of the manganese ore and ferromanganese imported; since 1927 the bureau has reported the gross weight of the ore but only the manganese content of the ferromanganese. This figure is a Bureau of Mines estimate of the gross weight of ore or alloy imported.

[5] Jan. 1 to Sept. 21, 1922. Figures represent gross weight of manganese ore imported.

[6] Sept. 22 to Dec. 31, 1922. Figures represent manganese content of ore imported.

[7] Figures represent manganese content of ore imported.

Manganese and manganiferous ore shipped from mines in the United States, 1920–1929, in long tons

Year	Manganese and manganiferous ores, exclusive of fluxing ore			Fluxing ore containing manganese		
	Ore containing 35 per cent of manganese or more	Ore containing 10 to 35 per cent of manganese	Ore containing 5 to 10 per cent of manganese	Ore containing 35 per cent of manganese or more	Ore containing 10 to 35 per cent of manganese	Ore containing 5 to 10 per cent of manganese[1]
1920	94,420	357,279	279,687	------------	123,970	6,728
1921	13,531	8,439	62,670	------------	22,962	3,028
1922	13,404	344,674	251,614	2,278	27,705	1,666
1923	31,500	319,666	1,072,457	769	40,770	1,004
1924	56,515	286,470	587,026	1,833	24,972	------------
1925	98,324	267,252	1,153,268	------------	25,384	2,150
1926	46,258	364,312	835,412	------------	17,707	------------
1927	44,741	148,291	1,310,127	------------	1,029	2,161
1928	46,860	90,581	1,085,401	------------	48	1,602
1929	60,379	78,191	1,110,067	------------	------------	------------

[1] Includes ore containing less than 5 per cent of manganese, as follows: 1920, 1,250 tons; 1921, 998 tons; 1922, 117 tons.

Manganese and manganiferous ore (exclusive of fluxing ore) shipped from mines in the United States, 1926–1929, by States

	Ore containing 35 per cent or more of manganese			Ore containing 10 to 35 per cent of manganese			Ore containing 5 to 10 per cent of manganese		
	Shippers	Long tons	Value	Shippers	Long tons	Value	Shippers	Long tons	Value
1926									
Metallurgical	30	26, 530	$379, 893	54	364, 312	$1, 179, 429	8	835, 412	$1, 934, 381
Chemical	4	19, 728	848, 770						
	34	46, 258	1, 228, 663	54	364, 312	1, 179, 429	8	835, 412	1, 934, 381
1927									
Metallurgical	36	27, 730	446, 781	47	148, 291	673, 921	9	1, 310, 127	3, 270, 460
Chemical	3	17, 011	705, 137						
	39	44, 741	1, 151, 918	47	148, 291	673, 921	9	1, 310, 127	3, 270, 460
1928									
Metallurgical:									
Alabama	2	(1)	(1)						
Arizona	5	3, 507	35, 500	1	214	(1)			
Arkansas	6	3, 623	81, 862	4	7, 136	43, 880			
Colorado				4	18, 599	99, 823			
Georgia	1	4, 727	(1)	8	4, 687	41, 322			
Idaho	2	(1)	(1)						
Michigan				2	7, 943	(1)	1	41, 261	(1)
Minnesota				1	3, 487	(1)	5	1, 025, 014	2, 471, 582
Montana	3	12, 044	(1)	1	11, 156	(1)			
New Mexico	3	2, 627	(1)	2	36, 250	(1)	1	19, 081	(1)
North Carolina	1	10	(1)						
Tennessee	2	55	(1)	5	718	6, 778	1	45	(1)
Utah				1	286	(1)			
Virginia	10	3, 071	50, 106	2	105	(1)			
Undistributed		1, 766	426, 093			215, 486			173, 583
Total metallurgical	35	31, 430	593, 561	31	90, 581	407, 289	8	1, 085, 401	2, 645, 165
Chemical:									
Montana	[2] 2	14, 689	621, 292						
Virginia	1	741							
Total chemical	3	15, 430	621, 292						
	38	46, 860	1, 214, 853	31	90, 581	407, 289	8	1, 085, 401	2, 645, 165
1929									
Metallurgical:									
Alabama				3	475	5, 854			
Arizona	3	2, 655	27, 826	1	45	181			
Arkansas	3	4, 308	94, 396	3	13, 774	98, 826			
California	4	569	8, 099						
Colorado				2	17, 770	(1)			
Georgia	2	2, 521	(1)	7	5, 310	57, 432			
Idaho	3	1, 326	13, 707	1	38	239			
Michigan				1	11, 023	43, 541	2	38, 089	(1)
Minnesota				1	5, 421	24, 991	5	1, 004, 420	2, 506, 081
Montana	3	29, 945	(1)	1	15, 665	(1)			
Nevada				5	2, 407	21, 462			
New Mexico	3	2, 969	50, 173				1	67, 558	(1)
Tennessee	3	523	12, 425	3	241	1, 810			
Texas	1	42	(1)						
Utah	2	88	(1)	2	5, 942	(1)			
Virginia	7	2, 651	52, 577	2	80	810			
Undistributed			776, 996			196, 697			316, 542
Total metallurgical	34	47, 597	1, 036, 199	32	78, 191	451, 843	8	1, 110, 067	2, 822, 623
Chemical:									
Montana	[2] 2	12, 382	576, 158						
Virginia	1	400							
Total chemical	3	12, 782	576, 158						
	37	60, 379	1, 612, 357	32	78, 191	451, 843	8	1, 110, 067	2, 822, 623

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(1) Included under "Undistributed."

[2] Mills through which all ore was shipped; producers not counted.

The following States produced, in the order named, substantial quantities of metallurgical ore in 1929: Montana, Arkansas, New Mexico, Arizona, Virginia, and Georgia. The output of Montana increased nearly 18,000 tons, or about 149 per cent; production in Arkansas and New Mexico increased 19 and 13 per cent, respectively. Arizona decreased 24 per cent and Virginia 14 per cent in 1929. Georgia decreased from 4,727 to 2,521 tons, or nearly 47 per cent. Chemical ore was produced in Montana and Virginia in 1929, the former contributing nearly 97 per cent of the total. Production in Montana in 1929 decreased from 14,689 to 12,382 tons, or about 16 per cent, while Virginia's output fell off 46 per cent.

The Domestic Manganese & Development Co. operated its sintering plant at Butte, Mont., practically the entire year. The beneficiation plant of the Georgia Manganese & Iron Co., at White, Ga., was finished and put in operation early in 1930. The new plant of the Hy-Grade Manganese Production & Sales Corporation was started, as were other plants in Virginia.

FERRUGINOUS MANGANESE ORE

Shipments of domestic ore containing 10 to 35 per cent manganese amounted to 78,191 long tons, valued at $451,843, in 1929, compared with 90,581 tons, valued at $407,289, in 1928, a decrease of about 14 per cent in tonnage and an increase of 11 per cent in value. The increase in value is attributed largely to increase in grade of the ore rather than in market price per unit of manganese.

MANGANIFEROUS IRON ORE

Shipments of manganiferous iron ore containing 5 to 10 per cent manganese amounted to 1,110,067 long tons, valued at $2,822,623, in 1929, compared with 1,085,401 tons, valued at $2,645,165, in 1928. In recent years there has been a tendency toward the use of lower-grade manganiferous iron ores in the manufacture of manganiferous pig iron, as is indicated by the 26 per cent increase in 1929 in the shipments of iron ores containing 2 to 5 per cent manganese; such shipments amounted to 1,612,000 long tons in 1929, compared with 1,277,000 tons in 1928.

CHEMICAL ORE

Production of chemical manganese ore in the United States has decreased steadily since 1924; shipments amounted to 12,782 long tons, valued at $576,158, in 1929, compared with 15,430 tons, valued at $621,292, in 1928. During 1929 the market was characterized by the importation of low-priced foreign ore and by decreased consumption caused by the substitution of socket power for batteries in radio sets. Thus far no sales of the high-grade by-product manganese ore from the Tainton process of extracting zinc from ores have been reported.

Chemical manganese ore shipped from mines in the United States, 1920–1929, by States

Year	Idaho		Montana		Virginia		Total	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
1920			14,809	(1)	18	(1)	14,827	$539,543
1921			11,129	$444,981	102	$3,000	11,231	447,981
1922			9,706	(1)	800	(1)	10,506	404,965
1923			19,540	646,225	900	40,000	20,440	686,225
1924			23,512	816,463	1,125	50,000	24,637	866,463
1925			20,529	825,970	1,622	77,000	22,151	902,970
1926	30	(1)	17,904	(1)	1,794	(1)	19,728	848,770
1927			16,382	(1)	629	(1)	17,011	705,137
1928			14,689	(1)	741	(1)	15,430	621,292
1929			12,382	(1)	400	(1)	12,782	576,158

[1] Bureau of Mines not at liberty to publish figures.

REVIEW BY STATES

ALABAMA

Shipments of ferruginous manganese ore were made from the Margemma Mining Co.'s property near Rock Run, Cherokee County. This material (dried) contained 20 per cent manganese, 21 per cent iron, and relatively high silica and phosphorus. Gaston Scott, of Montgomery, Ala., shipped some ore averaging 34 per cent manganese (dried), and the Bynum mines at Walnut Grove shipped two cars of ore averaging 40 per cent manganese (dried) or 34 per cent (natural). The Allen-Oden Ore Co.'s Mount Pinson mine in Jefferson County was idle in 1929, but the company expects to make shipments in 1930.

ARIZONA

In 1929 Arizona shipped 2,655 long tons of manganese ore, averaging (dried) 41 per cent manganese, 11 per cent iron, and 11 per cent silica, as compared with 3,507 tons of ore of similar grade in 1928. The larger part of this ore came from the Higgins mine at Bisbee; some ore was shipped from the Blue Ridge mine, near Winslow, and the Black Warrior mine, near Congress. The Black Warrior mine is said to have closed down recently. Developments at the Ben Williams property, on the main line of the Santa Fe between Kingman and Wickenburg, indicate a considerable tonnage of ore averaging under 10 per cent manganese. This ore consists of finely divided manganese oxides in a matrix of sand and clay, and occurs in beds which have been traced over a distance of 2½ miles. It is believed that the Bradley process will work effectively on this type of ore.

The Blue Ridge mine near Winslow, Coconino County, leased and operated by the Manganese Ore Co., shipped two cars of ore averaging 45 per cent manganese, 12 per cent silica, and 3 per cent iron. This property was transferred by Ben W. McCloskey and associates to the Manganese Ore Co. on May 22, 1929.

A small amount of ferruginous manganese ore, averaging 16 per cent iron and 34 per cent manganese, was shipped from Arizona in 1929.

ARKANSAS

In 1929 Arkansas shipped 4,308 long tons of ore, valued at $94,396, compared with 3,623 tons, valued at $81,862, in 1928. The ore shipped averaged about 47 per cent manganese (dried) with fairly high iron (6 to 11 per cent) and 4 to 10 per cent silica. The high-grade ore was largely concentrates. Shipments of ferruginous manganese ore in 1929 amounted to 13,774 tons, valued at $98,826, compared with 7,136 tons, valued at $43,880, in 1928. The ferruginous manganese ore shipped averaged about 26 per cent manganese (dried) and carried about 16 per cent iron, 14 per cent silica, and 12 per cent alumina. The operators in 1929 were the Arkansas Manganese Ore Co., Walter H. Denison, and A. B. Reither, all of whom are in the Batesville-Cushman field.

Miller & Rinehart did not ship during 1928 and 1929, but experimented with a process for concentrating their ore. Walter H. Denison, in addition to mining some ore from his property, purchased and marketed a considerable tonnage of ore produced by a number of independent companies. Much of this ore ran about 48 per cent manganese, and much of it ran about 26 per cent. The Club House mine was sold to W. H. Denison.

The Arkansas Manganese Ore Co. shipped a few cars of ore averaging 47 per cent manganese and several thousand tons of ferruginous manganese ore averaging about 25 per cent manganese and 16 per cent iron. This company holds a number of leases which have several years to run. The company also purchases ores from other operators.

The Cuyuna Iron Mining Co.'s property, the Aydelotte, at Cushman, was operated by A. B. Reither who shipped several hundred tons of ore averaging 42 per cent manganese and a similar amount of material containing 29 per cent manganese and 16 per cent iron.

CALIFORNIA

The Feather River mine, about 5 miles from Crescent Mills in Plumas County, shipped a number of cars of ore containing 42 per cent manganese. The proposed tram, 3,000 feet in length, from the mine to the railway has been installed. This mine is said to have been operated by a syndicate composed of Messrs. Levensaler, Milton, and Gallegos, but future operations will be conducted under the name of the Du Val Moore Co.

A small shipment of 43 per cent ore was made from a property near Owl Holes, and C. M. Langdon is said to have shipped 320 long tons of 42 per cent ore from Blythe, Riverside County, to a local steel company.

The Buckeye mine in Stanislaus County operated for a short while, as did the Owl Holes mine in San Bernardino County. The former shipped 52 per cent ore, whereas a shipment from the latter averaged 43 per cent manganese.

The C. M. Langdon property, 2 miles west of Cox Siding on the Santa Fe railway, near Blythe, was worked under lease to H. K. Thurber, who is said to have shipped some ore which contained 41 per cent manganese.

COLORADO

No shipments of high-grade manganese ore were made in 1929, but 17,770 long tons of ferruginous manganese ore was shipped from the Leadville district, compared with 18,599 tons in 1928. The shippers were Cramer & Co. and Charles Brink. The ore averaged 20.8 per cent manganese and 20.5 per cent iron.

The Colorado Fuel & Iron Co.[3] is using one furnace at the Minnequa works for the manufacture of ferromanganese from Montana ore. Formerly the ferromanganese used at Pueblo was purchased in New Orleans.

GEORGIA

Chiefly because of decreased output from the Cartersville district, the output of manganese ore from Georgia fell from 4,727 long tons in 1928 to 2,521 tons in 1929. Except for a small quantity of ore from Cedartown, all the ore shipped in 1929 was from the Cartersville district. The principal operators were the Georgia Manganese & Iron Co., Homer Green, the Collin's property, the Southern Leasing Co., and Gibson Bros.

The Georgia Manganese & Iron Co. has been developing its properties in the vicinity of White, Ga., during the past few years. It is said that this company now controls 12,000 acres of ground, a large portion of which contains manganiferous material. After considerable experimentation with a pilot mill, a process for concentrating the ores was worked out. The company is reported to have raised a considerable sum of money for the construction of a mill which is to have an ultimate monthly capacity of several thousand tons of concentrates averaging in excess of 35 per cent manganese. A large reservoir was built at the lower end of the property, and a rather complicated water-distributing system was established in order to apply hydraulic mining methods. Several pits were opened up along the strike of the mineralized belt, and monitors were installed. Water is delivered to the monitors at a pressure of about 200 pounds per square inch. The ore is hydraulicked into sumps at the bottom of the pits and thence is pumped to two preliminary log-washing plants where the clayey matrix which contains the manganiferous material is washed out, the tailings going to settling ponds. A large part of the water is recovered at the settling ponds and returned to the main reservoir to be reused. The concentrates are delivered to the main concentrating plant, where they are again log washed, jigged, and tabled to obtain the final product for shipment. The final concentrates are said to run 35 to 38 per cent manganese. The water from the mill-tailings pond is partly recovered and returned to the reservoir. The water system is apparently in closed circuit. The lift from the main reservoir to the hydraulicking pit is about 40 feet, and the water is carried in a 12-inch cast-iron main. The ratio of concentration of raw ore to final concentrates ranges from 35:1 to 50:1. The large amount of waste material discharged from the various plants is said to have led to a tailings disposal problem. The reserves of raw ore are not known. In May and June, 1930, the plant was producing 5,000 tons of concentrates a month.

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[3] American Metal Market, vol. 34, No. 231, Nov. 28, 1929, p. 1.

The Searcy mine at Cherry Log, Gilmer County, operated by C. M. Wacaster, mined nearly 100 tons of ore and shipped a car of ferruginous manganese ore which contained 16 per cent manganese as well as a high percentage of iron—in all having an unusually high metallic content. The owner reports that the lode, which dips about 68°, is opened up over a width of 2 to 4 feet. Float outcrops have been traced for over a mile, indicating an extension of the lode as now developed.

Small tonnages of high-grade and low-grade manganese ores were shipped by Gibson Bros. from a property near Cedartown, Floyd County. The better grade of ore ran about 37 per cent manganese and the low-grade ore averaged 28 per cent.

IDAHO

Shipments of manganese ore from Idaho in 1929 amounted to 1,326 long tons, averaging 36.5 per cent manganese (dried). Practically all the ore came from the Cleveland and Lava Hot Springs districts, Bannock County.

MICHIGAN

Shipments of ferruginous manganese ore from Michigan amounted to 11,023 long tons, averaging 16.61 per cent manganese (natural), in 1929, compared with 7,943 tons, averaging 16.8 per cent, in 1928. Shipments of manganiferous iron ore amounted to 38,089 long tons in 1929, compared with 41,261 tons in 1928; the ore shipped in 1929 averaged 9.51 per cent manganese and 39.68 per cent iron (natural). The producers were the Hanna Iron Ore Co. and the Verona Mining Co. in the Iron River district, and the Balkan Mining Co. at Alpha, all in Iron County.

MINNESOTA

During 1929 production of ferruginous manganese ore in Minnesota amounted to 5,421 long tons, compared with 3,487 tons in 1928, an increase of 55 per cent. Shipments of manganiferous iron ore totaled 1,004,420 tons in 1929, compared with 1,025,014 tons in 1928, a small decrease. The production in 1929 came from Ironton, Riverton, and Crosby in Crow Wing County, the producers being the Evergreen Mining Co. (Evergreen mine); the Amherst Mining Co. (Milford mine); the Manganiferous Iron Co. (Louise, Hillcrest, and Merritt mines); the Cuyuna Ore Co. (Mahnomen-Sultana-Hopkins mines); and the Sagamore Ore Mining Co. (Sagamore mine).

The manganiferous iron ore averaged 7.52 per cent manganese and 36.63 per cent iron, while the ferruginous manganese ore averaged 17.11 per cent manganese and 30.64 per cent iron (natural).

An article[4] by Joseph, Barrett, and Wood describes a process designed to treat the low-grade manganiferous material found in certain parts of the Cuyuna range. The process is being developed at the Minneapolis station of the United States Bureau of Mines.

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[4] Joseph, T. L., Barrett, E. P., and Wood, C. E., Experiments Demonstrate Method of Producing Artificial Manganese Ore: Trans. Am. Inst. Min. and Met. Eng., Tech. Pub. 310, 1930, 30 pp.

MONTANA

Shipments of metallurgical ore from Montana in 1929 amounted to 29,945 long tons, compared with 12,044 tons in 1928, most of which in both years was sintered rhodochrosite from the Butte plant of the Domestic Manganese & Development Co. In 1929 this plant treated 47,025 long tons of rhodochrosite from the Emma mine, averaging 37.6 per cent manganese, and produced 29,041 tons of sinter averaging about 57.8 per cent manganese. In 1928 this company treated 18,595 long tons of rhodochrosite and produced 11,118 tons of sinter, and in 1927 it treated 6,430 tons of rhodochrosite and produced 4,114 tons of sinter.

The Emma mine, at Butte, was the chief source of manganese ore in 1929. During that year it shipped 51,880 long tons of rhodochrosite, averaging 37.3 per cent of manganese, to the sintering plant of the Domestic Manganese & Development Co., at Butte. In addition, it shipped 697 tons of rhodochrosite, averaging 39.74 per cent of manganese, to consumers in Illinois, Washington State, and California. The total shipments from the Emma mine in 1928 were 19,426 tons. Some oxide ore averaging 35 per cent manganese was shipped from Philipsburg.

The shipments of chemical ore from Philipsburg in 1929 amounted to 12,382 long tons, compared with 14,689 tons in 1928. The shippers were the Moorlight Mining Co. and the Trout Mining Co. In addition, 15,665 tons of manganese ore (tailings) averaging about 24 per cent manganese (dried) was shipped from the Philipsburg district. The reserves[5] of the Philipsburg district have been estimated as follows: In zone 1 (from the surface to a depth of 150 feet) the reserves are only about 60,000 tons, this zone having yielded most of the ore produced to date. Zone 2 (150 to 450 feet) is partly explored, and the reserves are estimated at 927,000 tons. Zone 3 (450 to 750 feet) is not penetrated by mine workings, but from geological indications it is estimated to contain 800,000 tons of manganese ore.

The most important development in the Butte district in 1929 was the successful floating of rhodochrosite ore containing lead and zinc sulphides and the obtaining of separate concentrates of rhodochrosite and lead and zinc sulphides.[6]

The following summarizes the reserves of carbonate ore in the Butte district.[7]

> The Butte area of Montana contains large quantities of manganese ore in the form of the carbonate ore, rhodochrosite, which is associated with rhodonite quartz and small quantities of lead and zinc in the form of sulphides. The Domestic Manganese and Development Co. is at present working a deposit at the Emma mine, where it mines the high-grade ore which is calcined to produce a very high-grade concentrate. In addition to the ore that is susceptible to treatment by this method, there are large tonnages of lower-grade ore which, because of its complexity, must be concentrated before calcination if a high-grade product is to be produced. * * *
>
> In addition to the Butte deposits of the carbonate ore there seems to be little question that at depth in the Philipsburg district, Montana, large amounts of the carbonate of manganese will be encountered. Smaller bodies of carbonate ore are known to occur near Sevierville, Tenn., and near West Cummington, Mass.

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[5] Pardee, J. T., Manganese Ore Reserves at Philipsburg, Mont.: U. S. Geol. Survey Press Memo., Oct. 16, 1929, pp. 4–5.

[6] Engineering and Mining Journal, vol. 129, No. 1, Jan. 9, 1930, p. 44.

[7] DeVaney, F. D., and Clemmer, J. Bruce, Flotation of Carbonate and Oxide Manganese Ores: Proc. 2d Ann. Conv. of the Am. Manganese Prod. Assoc. 1929, pp. 83–84.

NEVADA

Shipments of ferruginous manganese ore from Nevada amounted to 2,407 long tons in 1929; no shipments were made during 1928. Most of this ore runs between 32 and 34 per cent manganese. The shipments came largely from the Ely (Robinson) district, and the main operators were R. A. Millick and the Cuba Mining Co. Shipments were also made from the Golconda district in Humboldt County and from the Nevada Metals mine in Lincoln County.

The latest developments in the Las Vegas district indicate a reserve of several hundred thousand tons of ore containing between 27 and 37 per cent manganese; some of this ore, however, is reported to be of a much higher grade. The material has been tested by the Bradley process, and is said to have given very favorable results. The property is being developed by the Chapin Exploration Co.

NEW MEXICO

Shipments of manganese ore from New Mexico in 1929 amounted to 2,969 long tons, compared with 2,627 tons in 1928. The ore averaged about 46 per cent manganese (dried) in 1929, and came from Luna and Grant Counties.

No shipments of ferruginous manganese ore were made in 1929, compared with shipments of 36,250 long tons in 1928.

Shipments of manganiferous iron ore amounted to 67,558 long tons in 1929, averaging about 8 per cent manganese and 27 per cent iron, compared with 19,081 tons in 1928; these ores are mined by the Colorado Fuel & Iron Co. from the Kirchman property near Silver City.

The Manganese Valley mines, in the Little Florida mountains east of Deming and operated by R. H. West, shipped nearly 2,900 long tons of ore in 1929, averaging 46 per cent manganese. The Luna Manganese Co., in the same district, began shipments toward the end of 1929 and expects to continue in 1930, provided contracts for this type of ore can be made in competition with low-cost foreign ores. This company has been doing considerable development work, including a shaft to 550 feet, where sufficient water was struck to supply the needs of the new mill now being constructed. The first unit of the mill was ready for operation near the end of 1929. The plant has been described as follows: [8]

> A concentrating mill has been erected and first unit will be in operation in ten days. This unit is provided with Blake-type crusher capable of crushing, with assistance of rolls, 600 tons per day. A large Bull jig with a capacity of 600 tons a day for primary classification is installed and eight Hartz jigs are in place for first unit and 16 more on the location for units to follow. It is planned to use two Wilfley tables for each unit to recover fines from crushing and four more tables are on ground for future units. From tests made on mill concentration the majority of shipping ore will not be less than ⅝ inch and a large proportion will be in chunks weighing about 40 pounds each. * * * It is planned to install additional units as fast as possible. The mill, mine, and houses on location will be electrically lighted and all equipment motor driven from Diesel engine which is now being set up and will be completed by the time this report is read.

The Manganese Valley Mines (Inc.) and the Luna Manganese Co. have done considerable development work, and officials of these companies believe that the ultimate reserves of the district will be several hundred thousand tons of concentrating ore. So far the development work has been confined to about 6,000 feet along the main lode, 2,400 feet of which has been proved by drifting. The width of the lode varies from 5 to 22 feet. The Manganese Valley Mines intends to deepen the mine in 1930 and plans to complete the second unit of the washing plant.

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[8] Spencer, W. R., Proc. 2d Ann. Conv. of the Am. Manganese Prod. Assoc., 1929, pp. 27–28.

SOUTH DAKOTA

The Chamberlain deposit has recently been described by D. F. Hewett, of the United States Geological Survey, as follows:[9]

> The quantity of manganese metal contained in the 38-foot bed of concretions in these nine townships is obviously very large, and while it is much larger both per unit of area and as a whole than is known in most localities where manganese minerals occur in definite beds, the quantity of manganese per cubic yard of shale is low—much lower, in fact, than in any material thus far treated as a source of manganese. As shown above, the total quantity is estimated to be about 100,000,000 tons. The manganese content of the concretions in the entire bed in these nine townships probably averages about 25 pounds per cubic yard of shale, which, if converted to a high-grade product fit for smelting to ferromanganese, would be worth at present prices about 60 cents (2.4 cents per pound of manganese). The data indicate, however, that the richest 10-foot zone, 26 per cent of the total volume, contains about 36,000,000 tons, or about 36 per cent of the manganese. Material estimated to contain about 15,000,000 tons of manganese could probably be recovered from this 10-foot zone in area A alone. Most of this material lies within 4 miles of the railroad. In this area the average manganese content is about 40 pounds per cubic yard of shale, and at present prices it would be worth about 96 cents per cubic yard. As this sum must cover cost of mining, separation of nodules from shale, chemical recovery of the manganese, and transportation to the smelter, it is not yet certain whether this material can be worked so as to yield a profit at prevailing prices. In view of the unusual character of this material and the lack of demonstrated methods of treatment it does not seem justifiable at present to include the material in estimates of national reserves of manganiferous ores. Viewed as a national asset under a great emergency, however, when cost of treatment is a secondary element, it deserves consideration.

The General Manganese Corporation now controls about 125,000 acres in the field. A hydrochloric acid leaching process for the beneficiation of this ore is said to have been worked out, and it has been stated that concentrates (sinter) could be produced which would contain upward of 70 per cent manganese, 29 per cent oxygen, and 0.01 per cent phosphorus. A recent announcement[10] states that a subsidiary company, the Oacoma Corporation, has been organized under the laws of South Dakota to develop hydroelectric power and at a later date to take over leases covering mineral rights other than manganese on several thousand acres. It also will provide power for the General Manganese Corporation undertaking.

TENNESSEE

Shipments of manganese ore, containing 35 per cent or more of manganese, from Tennessee amounted to 523 long tons in 1929, compared with 55 tons in 1928. The ore in 1929 came from a property near Shady Valley, in Johnson County; the Roan Mining Co. mine, in Carter County; and the Red Hill mine, in Bradley County. The Doe River Mining Co. sold its mine at Hampton to the Roan Mining Co. in September, 1929; the latter company is said to have begun the construction of a mill.

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[9] Hewett, D. F., Manganese-Iron Carbonate near Chamberlain, S. Dak.: U. S. Geol. Survey Press Memo., Feb. 5, 1930.

[10] American Metal Market, vol. 37, No. 88, May 7, 1930, p. 9.

Shipments of ferruginous manganese ore in 1929 amounted to 241 tons, most of which came from the Zenith Mining Co.'s property in Carter County; small quantities came from a property near Shady Valley in Johnson County and from a property near Calhoun in McMinn County.

The carbonate deposits at Sevierville may some day be mined and the ore treated by sintering methods.

TEXAS

A car of 43 per cent manganese ore was shipped by Joe Darnell in 1929 from his property near Chispa in Jeff Davis County. Recent reports indicate that L. C. Butler & Sons, New Dorf, Staten Island, New York City, plan to reopen the Spiller mine near Llano, Mason County.

UTAH

Shipments of ore containing 35 per cent or more manganese from Utah amounted to 88 long tons in 1929; no shipments were made in 1928.

Shipments of ferruginous manganese ore increased from 286 long tons in 1928 to 5,942 tons in 1929, or more than twentyfold. The ferruginous manganese ore in 1929 averaged between 20 and 23 per cent manganese and only 5 to 10 per cent iron, and practically all of it came from the Black Boy mine, at Lucerne, Juab County, and the Chief Consolidated mine, at Homansville, Utah County. Fred Staats, operating the Black Boy mine, states that he has noted the presence of a considerable tonnage of rhodonite and rhodochrosite in veins in that vicinity.

VIRGINIA

The production of manganese ore in Virginia in 1929 amounted to 2,651 long tons of metallurgical ore and 400 tons of chemical ore, compared with 3,071 tons of metallurgical ore and 741 tons of chemical ore in 1928.

The principal mines were those operated by the Hy-Grade Manganese Production & Sales Corporation, the Bruce & Horne Manganese Co., the Dunn Manganese Co., the Virginia Manganese & Mining Corporation, D. W. Salyer, and the Stange Construction Co. Except the Mineral Ridge mine, which is in Shenandoah County, practically all the mines are in the vicinity of Pearisburg and Crandon in Giles and Bland Counties. The ore shipped from this region in 1929 averaged between 38 and 49 per cent manganese, with low iron and 10 to 16 per cent silica. The Stange Construction Co. at Flat Top Mountain (Stange mine) near Pearisburg has mined several thousand tons of ore which is awaiting the construction of a washing plant. The property is reported to comprise about 40,000 acres. The stripping operations have been carried on by means of power shovels.

The Manganese Corporation of America plans to operate the Lucas mine, at Leesville, Campbell County, which was acquired January 1, 1930, on a 6-month lease option. Two shafts three-fourths of a mile apart will be sunk in order to test the ground. Several cars of good ore are said to have been shipped from this property about 25 years ago.

John W. Tobin shipped some 47 per cent and some 34 per cent ore from Louisa, in Louisa County.

The Hy-Grade Manganese Production & Sales Corporation, at the Mineral Ridge mine near Woodstock, Shenandoah County, shipped several hundred tons of chemical ore averaging about 78 per cent MnO_2 and a small quantity of metallurgical ore averaging 47 per cent manganese. The pilot mill has been closed down and a new plant of the gravity concentration type is under construction.

The Stanley Manganese Mines Co. did development work at the Eureka mine near Stanley, Page County. The owner expects to ship ore during 1930, following the remodeling of the mill. A small tonnage of 38 per cent manganese ore was produced by development work.

The chief deposit in the Blue Ridge area is about 2 miles east of Crimora, a station on the Norfolk & Western Railway, in Augusta County. This is known as the Old Dominion or Harman property, and has been undergoing intensive drilling during the past two years. The owners claim [11] a total reserve of several hundred thousand tons of concentrating ore distributed over an area of approximately 12 acres.

The American Manganese Fertilizer Corporation [12] of Alexandria, Va., with a maximum capital of $550,000 has been given a charter to explore, develop, and operate mines and manufacture fertilizers.

PRODUCERS AND CONSUMERS OF DOMESTIC MANGANESE ORE

Following is a partial list of the producers and consumers of domestic metallurgical and chemical ore (35 per cent or more metallic manganese content) in 1929. Notification of any changes in this list will be welcomed by the Bureau of Mines.

PRODUCERS OF MANGANESE ORE

Arizona:
  Black Warrior Mines Co. (out of business), Congress.
  Manganese Ore Co., Winslow.
  Phelps-Dodge Corporation, Bisbee.
Arkansas:
  Arkansas Manganese Ore Co., Batesville.
  Walter H. Denison, Cushman.
  A. B. Reither, Cushman.
California:
  C. M. Langdon, Blythe.
  J. A. Levensaler, 114 Sansome Street, San Francisco.
  Manganese Mines Co., 304 New Call Building, San Francisco.
  H. K. Thurber, Phoenix, Ariz.
  J. W. Wood, San Bernardino.
Georgia:
  Georgia Manganese & Iron Co., Atlanta.
  D. F. & J. T. Gibson, Cedartown.
Idaho:
  Jack O. Currence, Lava Hot Springs.
  Western Manganese Co., Cleveland.
  R. E. Wickham, Lava Hot Springs.
Montana:
  Anaconda Copper Mining Co., Butte.
  Domestic Manganese & Development Co., Butte.
  Moorlight Mining Co., Philipsburg.
  Trout Mining Co., Philipsburg.

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[11] American Metal Market, vol. 36, No. 178, Sept. 13, 1929, p. 7.
[12] The American Fertilizer, vol. 71, No. 5, Aug. 31, 1929, p. 25.

New Mexico:
  Luna Manganese Co., Deming.
  Manganese Valley Mines (Inc.), Deming.
  Starkey & Perry, Deming.
Tennessee:
  Roan Mining Co., Hampton.
  A. T. Short, Atkins, Va.
  J. T. Thomasson, Chattanooga.
Texas: Joe Darnell, Alpine.
Utah:
  Thomas Chatwin, Mammoth.
  Fred Staats, Provo.
Virginia:
  Bruce & Horne Manganese Co., Crandon.
  Dunn Manganese Co., Crandon.
  Hy-Grade Manganese Production & Sales Corporation, Woodstock.
  D. W. Salyer, Crandon.
  Stange Construction Co., 1600 Arch Street, Philadelphia, Pa.
  Stanley Manganese Mines, Stanley.
  John W. Tobin, 46 Cedar Street, New York, N. Y.
  Virginia Manganese & Mining Corporation, Crandon.

CONSUMERS OF DOMESTIC HIGH-GRADE METALLURGICAL MANGANESE ORE

Buckeye Steel Castings Co., Columbus, Ohio.
Bunker Hill & Sullivan Mining & Smelting Co., Bradley, Idaho.
Carus Chemical Co., La Salle and Joliet, Ill.
Colorado Fuel & Iron Co., Pueblo, Colo.
Evans-Wallower Zinc Co., East St. Louis, Ill.
Lavino Furnace Co., Reusens, Va., and Marietta and Sheridan, Pa.
National Paint & Manganese Co., Lynchburg, Va.
Ohio Ferro-Alloys Corporation, Philo, Ohio.
Pacific Coast Borax Co., Los Angeles, Calif.
Pacific Coast Steel Corporation, Seattle, Wash.
F. E. Schundler & Co., Joliet, Ill.
Tennessee Coal, Iron & Railroad Co., Bessemer and Ensley, Ala.
United States Steel Corporation, Etna and Pittsburgh, Pa.
U. S. Steel Products Co. (formerly Columbia Steel Corporation), Ironton, Utah, and Torrance, Calif.

CONSUMERS OF DOMESTIC CHEMICAL MANGANESE ORE

Bond Electric Co., Jersey City, N. J.
Bright Star Battery Co., Hoboken, N. J.
Burgess Battery Co., Freeport, Ill., and Niagara Falls, Ontario, Canada.
Carbon Products Co., Lancaster, Pa.
Dominion Dry Battery Co., Toronto, Canada.
Folsom Battery Co., Chicago, Ill.
French Battery Co., Madison, Wis.
E. J. Lavino, Plymouth Meeting, Pa.
Marathon Battery Co., Wausau, Wis.
National Carbon Co., Cleveland and Fremont, Ohio.
St. Louis Sulphur & Chemical Co., St. Louis, Mo.
U. S. Electric Co., New York, N. Y.

PRICE OF MANGANESE ORE

The quoted prices of manganese ore in 1929, according to the Engineering and Mining Journal, were as follows:

1. Brazilian and Indian ore, containing a minimum of 47 per cent manganese, began at 34 to 35 cents and was steady during the first quarter. In April the price dropped to 30 to 32 cents and remained thus until the end of August, when the price rose and was maintained at 31 to 34 cents until the end of the year.

2. Cuban ore, containing a minimum of 47 per cent manganese, was quoted for the first time in September at 35 cents a unit, at which price it remained until November, but in December it dropped to 34 cents.

3. Chilean ore, containing a minimum of 47 per cent manganese, was quoted at 35 cents in October and dropped to 34 cents in December.

4. Caucasian washed ore, averaging 53 to 55 per cent manganese, started at 35 to 37 cents in January, rose to 37 to 39 cents in February, and held at 36 to 38 cents during the second quarter of the year. The quoted price was constant at 36 cents during the second half of 1929.

Chemical ore, c. i. f. Atlantic seaboard, was quoted as follows:

(*a*) Domestic ore, containing 70 to 72 per cent manganese dioxide, was constant at $40 to $50 throughout the year.

(*b*) Montana ore, averaging 70 to 75 per cent manganese dioxide, opened and was steady at $70 to $80, but quotations were the same as for domestic 70 to 72 per cent ore thereafter. Domestic ore is quoted f. o. b. shipping point.

(*c*) Brazilian, Japanese, and Cuban ore, averaging 82 to 87 per cent manganese dioxide, was steady at $70 to $80 until October, when the price dropped to $60 to $65, and remained there until the end of the year.

(*d*) Caucasian ore, containing 85 per cent manganese dioxide, began at $70 and continued at this price through September, but was quoted at $60 to $65 during the last quarter.

IMPORTS OF MANGANESE ORE

The following table shows the imports of manganese ore into the United States, 1927 to 1929, by countries.

Manganese ore imported into the United States, 1927–1929

[General imports]

Country	1927			1928			1929		
	Ore (long tons)	Manganese content (long tons)	Value	Ore (long tons)	Manganese content (long tons)	Value	Ore (long tons)	Manganese content (long tons)	Value
Africa:									
British—									
Gold Coast	87, 230	42, 172	$478, 214	24, 186	11, 712	$145, 059	33, 593	16, 058	$366, 130
South				5	3	73			
Egypt							101	58	4, 762
Brazil	174, 026	78, 602	1, 584. 836	142, 300	64, 290	819, 615	216, 535	93, 961	1, 427, 160
Canada	430	228	9, 660	3, 929	2, 234	101, 422	4, 804	2, 646	102, 975
Chile	3, 206	1, 470	36, 054	9, 340	4, 423	118, 208	2, 000	884	21, 000
Cuba	8, 976	4, 211	141, 836	3, 180	1, 556	60, 402	2, 667	1, 959	32, 654
Germany	65	37	4, 331	133	68	8, 007	1, 137	569	34, 148
India (British)	93, 017	47, 863	1, 185, 610	83, 600	43, 072	1, 037, 942	72, 940	37, 479	968, 443
Italy							71	60	8, 933
Java and Madura	1, 527	863	42, 276	1, 026	792	26, 580	1, 000	571	25, 093
Soviet Russia in Europe	253, 544	133, 159	5, 000, 279	159, 842	79, 529	3, 067, 259	329, 336	169, 121	5, 452, 366
United Kingdom	46	25	3, 920	167	129	11, 382	85	49	7, 154
	622, 067	308, 630	8, 487, 016	427, 708	207, 808	5, 395, 949	664, 269	323, 415	8, 450, 818

The imports of manganese ore in 1929 totaled 664,269 long tons (containing 323,415 tons of metallic manganese), valued at $8,450,818, as compared with 427,708 tons (containing 207,808 tons of metallic manganese), valued at $5,395,949, in 1928, an increase of 55 per cent in quantity, 56 per cent in manganese content, and 57 per cent in total value.[13] Russia, Brazil, British India, and Gold Coast, in the order named, were the principal countries exporting to the United States in 1929; they contributed 98.2 per cent of the total ore imported in 1929, 95.8 per cent in 1928, and 97.7 per cent in 1927. Imports from Russia, Brazil, and Gold Coast increased materially; those from British India decreased.

The following table shows the percentage distribution of manganese ore imported into the United States, 1927 to 1929, by countries.

Percentage distribution of manganese ore imported into the United States, 1927–1929, by countries

Country	1927	1928	1929
Soviet Russia in Europe	40.8	37.4	49.6
Brazil	28.0	33.3	32.6
India (British)	14.9	19.5	11.0
Gold Coast	14.0	5.6	5.0
Other countries	2.3	4.2	1.8
	100.0	100.0	100.0

The increase in imports from Russia and others more than offset the decline in imports from India. India was handicapped by longer rail and ocean hauls than Russia and Gold Coast. Brazilian ores are produced by American companies which consume their own product and consequently are apt to be less affected by shifting market conditions.

Imports of ferruginous manganese ore containing 10 to 29 per cent manganese amounted to about 164,000 long tons in 1929. This ore came from Australia, 41,000 tons; Brazil, 77,000 tons; and Egypt (Sinai Peninsula), 46,000 tons.

A considerable tonnage of iron ore containing 3 to 10 per cent manganese was imported from Algeria and other States in northern Africa and from Sweden and Spain. This material was imported because of its high metallic content and low phosphorus, and much of it was used in the manufacture of pig iron.

The following tables show the nationality of bottoms carrying manganese ore into the United States in the calendar years 1927, 1928, and 1929.

Nationality of bottoms carrying manganese ore into the United States and per cent of total carried by each, 1927–1929

Nationality of bottoms	1927	1928	1929
United States	24.7	37.2	29.8
Brazilian	2.5	-------	.6
British	46.9	39.4	41.7
Danish	4.3	3.2	.8
Dutch	1.2	.4	([a])
French	10.4	7.6	-------
German	2.7	6.2	2.1
Greek	1.2	2.7	1.2
Italian	-------	([a])	18.4
Japanese	-------	-------	2.1
Norwegian	2.9	2.0	3.1
Swedish	2.5	-------	-------
Other [b]	.7	1.3	.2
	100.0	100.0	100.0

[a] Included under "Other."

[b] 1927: Honduran, Panaman, and Spanish; 1928: Honduran, Italian, Panaman, and Spanish; 1929: Dutch, Panaman, and Spanish.

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[13] The value quoted in the import tables represents invoice value and not the price paid for the ore.

The proportion of the total carried by Italian and British ships increased materially, whereas the proportion carried by American bottoms decreased. Italian ships carried nearly 140,000 tons, or 18.4 per cent of the total ore imported in 1929, compared with a negligible amount in 1928. Evidently Italian bottoms absorbed much of the trade from Soviet Russia previously handled by Danish, Dutch, and French ships. French bottoms carried 7.6 per cent of the total in 1928; they carried none in 1929. Japanese ships carried 2.1 per cent of the total in 1929, entering the field for the first time.

Nationality of bottoms carrying manganese ore into the United States, 1927–1929, in long tons [1]

Country of origin	Flag	1927	1928	1929
Brazil	United States (Independent)	92,050	124,950	156,400
	Brazilian	15,700		4,490
	British	45,950	63,200	84,650
	Dutch	6,750		
	Norwegian		50	
	Swedish	8,400		
		168,850	188,200	245,540
Chile	United States (Independent)	2,000	1	2,000
	Norwegian	1,016	1,401	
	Panaman	4,400	6,231	
		7,416	7,633	2,000
Honduras	United States (Independent)			63
Costa Rica	Norwegian			95
Cuba	United States (Independent)	1,243	384	610
	British	1,186	625	180
	Danish	4,600		
	Dutch		900	
	German			110
	Norwegian	2,070	36	1,448
	Panaman		263	200
		9,099	2,208	2,548
Jamaica	Honduran		70	
Dominican Republic	British		40	
Guatemala	Honduran	43		
Scotland	British			11
Belgium	United States (United States Shipping Board)			21
England	do	5,033	7,931	13,192
	United States (Independent)	3,500	11,033	6,440
	British	2,574	4,988	4,521
		11,107	23,952	24,153
Norway	United States (Independent)	1,600		
	Danish	1,800	3,850	6,089
	Norwegian	3,500	8,791	14,060
		6,900	12,641	20,149
Sweden	Swedish	10		
Germany	British		35	
	German	11	61	74
	Norwegian	11		
		22	96	74
France	United States (United States Shipping Board)	41	93	135
Italy	United States (Independent)		117	1,273
	Italian		151	383
	Norwegian		382	641
	Spanish	189	224	596
		189	874	2,893

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[1] Division of Statistics, Bureau of Research, U. S. Shipping Board, Special Report B. R. No. 1597, June 4, 1930. Subject to revision. These figures include ore held in bonded warehouses and not classed as ore imported for consumption; they may include some ferruginous manganese or manganiferous iron ores. Probably some of the surplus over imports for consumption was reexported.

Nationality of bottoms carrying manganese ore into the United States, 1927–1929, in long tons—Continued

Country of origin	Flag	1927	1928	1929
Union of Soviet Socialist Republics (Black Sea).	United States (Independent)	--------	--------	3,000
	British	133,393	51,663	153,175
	Danish	21,377	13,178	--------
	French	66,677	39,675	--------
	German	17,343	32,394	15,960
	Greek	7,403	14,372	9,100
	Italian	--------	--------	139,246
	Japanese	--------	--------	16,000
	Norwegian	11,765	--------	7,000
		257,958	151,282	343,481
Algeria	British	--------	5,350	5,800
	Swedish	7,641	--------	--------
		7,641	5,350	5,800
Gold Coast	United States (United States Shipping Board)	7,512	--------	--------
	United States (Independent)	--------	--------	5,099
	British	63,095	25,076	28,745
		70,607	25,076	33,844
Tanganyika Territory	do	--------	--------	98
Nigeria	do	--------	4	--------
Egypt	do	--------	--------	101
Australia	United States (United States Shipping Board)	--------	4,500	4,279
India	do	35,425	31,170	10,006
	United States (Independent)	9,476	14,250	23,750
	British	53,200	52,600	35,000
		98,101	98,020	68,756
Java	do	542	--------	533
	Dutch	868	1,059	533
		1,410	1,059	1,066
Atlantic Canada	United States (Independent)	--------	1,500	--------
	British	--------	3,536	4,419
		--------	5,036	4,419
Summary	United States (United States Shipping Board)	48,011	43,694	27,633
	United States (Independent)	109,869	152,235	198,635
	Brazilian	15,700	--------	4,490
	British	299,940	207,117	317,233
	Danish	27,777	17,028	6,089
	Dutch	7,618	1,959	533
	French	66,677	39,675	--------
	German	17,354	32,455	16,144
	Greek	7,403	14,372	9,100
	Honduran	43	70	--------
	Italian	--------	151	139,629
	Japanese	--------	--------	16,000
	Norwegian	18,362	10,660	23,244
	Panaman	4,400	6,494	200
	Spanish	189	224	596
	Swedish	16,051	--------	--------
		639,394	526,134	759,526

FOREIGN FERRUGINOUS MANGANESE ORE CONSUMED

During 1929 the United States consumed 115,664 long tons of foreign ferruginous manganese ore, containing 27,489 tons of metallic manganese, from the following sources:

Foreign ferruginous manganese ore consumed in the United States in 1929

Country	Ore (long tons)	Metallic manganese content	
		Per cent	Long tons
Brazil	67, 638	27. 02	18, 278
Australia	35, 536	16. 27	5, 783
India	6, 808	26. 89	1, 831
Sinai Peninsula	3, 739	27. 40	1, 024
Palestine	1, 943	29. 50	573
	[1] 115, 664	23. 77	27, 489

[1] Equivalent to about 55,000 tons of 50 per cent manganese ore.

FOREIGN MANGANIFEROUS IRON ORE CONSUMED

During 1929 the United States consumed 50,505 long tons of foreign manganiferous iron ore. This material contained 3,360 tons of metallic manganese and was supplied by the following countries:

Foreign manganiferous iron ore consumed in the United States in 1929

Country	Ore (long tons)	Metallic manganese content	
		Per cent	Long tons
Africa	46, 686	6. 72	3, 137
Sweden	3, 557	5. 84	208
Spain	262	5. 79	15
	50, 505	6. 65	3, 360

TREATMENT OF LOW-GRADE MANGANESE ORE

In view of the fact that there is possibly 200,000,000 tons of low-grade manganiferous material in the United States to which certain beneficiation processes may be applied in the future, it may be of interest to outline the occurrence of manganese ores and the methods that have been developed for treating these ores.

The manganese deposits of the United States were classified by the United States Geological Survey [14] in 1918, as follows:

1. Stratiform masses.

(*a*) Oxides interlayered with sediments or layered volcanic or metamorphic rocks. (Cordilleran and Appalachian regions, mainly the former.)

(*b*) Carbonates or silicates interlayered with sediments or layered volcanic or metamorphic rocks. (California (Sierra Nevada and Coast Ranges), South Carolina, and Texas.)

(*c*) Oxides, as surface bog deposits. (Montana.)

2. Veins and breccia fillings.

(*a*) Oxides in larger part. (Largely in Cordilleran region; other scattered deposits in Virginia, New Jersey, Arkansas, Oklahoma, South Dakota, Wyoming, and in certain Rocky Mountain States.)

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[14] Hewett, D. F., Manganese and Manganiferous Ores in 1918: U. S. Geol. Survey, Min. Resources of the United States, 1918, pt. 1, 1920, pp. 641–642.

(*b*) Carbonates or silicates partly weathered to oxides. (Colorado, Oklahoma, and New Mexico.)

3. Irregular masses.

(*a*) Oxides. (Largely in the Cordilleran and Rocky Mountain regions, Lake Superior, and a few scattered occurrences in the Appalachian belt.)

(*b*) Carbonates or silicates largely weathered to oxides. (Montana, Massachusetts, and Maine.)

4. Aggregates of small bodies in clay or weathered rocks.

(*a*) Mainly oxides. (Common type in Appalachian belt, Batesville, Ark., and Missouri.)

5. Unclassified deposits. (California, Colorado, Montana, and elsewhere.)

Since 1918 several new deposits have been located which may lead to the addition of two new types, as follows:

6. Carbonate nodular bedded deposits, which appear to be sedimentary in South Dakota.

7. Oxide deposits at Las Vegas, Nev., which may possibly be of spring origin.

The methods developed, so far, for the treatment of the different types of low-grade manganiferous ores may be summarized as follows:

1. Gravity concentration.
   - (*a*) Jigs.
   - (*b*) Tables.
   - (*c*) Log washers.
   - (*d*) Sluices.
   - (*e*) Flotation (ordinary).
   - (*f*) Heavy-liquid method.
2. Chemical beneficiation.
   - (*a*) Ammonium sulphate leaching by the Bradley process.
   - (*b*) Hydrochloric acid leaching by the Leute process.
3. Pyrometallurgical.
   - (*a*) Bureau of Mines blast-furnace method.
   - (*b*) Roasting of carbonates or oxides.
4. Magnetic separation.
   - (*a*) Straight magnetic separation.
   - (*b*) Roasting followed by magnetic separation.
5. Selective flotation to remove deleterious constituents.
6. Volatilization.
7. Desliming of limonite and other soft oxides.
8. Combinations of the first seven methods.

Gravity concentration methods are used extensively in several places and are applicable to nearly all classes of ores in which the deleterious constituents are not intimately combined with the manganese minerals. Plants of this sort have been built in Georgia (Cartersville district), in Virginia (Woodstock and Stange), and other places in the Appalachian region to separate psilomelane, pyrolusite, manganite, wad, and other manganese minerals from clayey gangue and weathered rocks. Gravity concentration is also employed in New Mexico and other places in the Cordilleran region for separation of the manganese matrix from breccia-fragments in the breccia filling type of deposit. Log washers and other washing methods are used in the Lake Superior region to effect a slight concentration of manganiferous and iron ores by removal of clay, etc. Many combinations of gravity concentration equipment have been tried successfully, but flotation and heavy-liquid separation are still in the laboratory stage. Flotation of psilomelane has been tried with some success at the Rolla Station [15] of the Bureau of Mines in Missouri, and the process seemed particularly applicable to Appalachian ores. In the heavy-liquid process [16] the ore is first wetted in a layer of water overlying acetylene tetrabromide, a heavy liquid with a specific gravity of 3. The heavier manganese minerals settle through the heavy liquid and the lighter gangue minerals float on top. Color and luster play no part in the process, as it is designed to handle ores similar to those of the Appalachian region which are embedded in clay or weathered rock gangues.

Chemical separation methods were developed to handle two types of ores—carbonates at Chamberlain, S. Dak., and oxides in irregular masses on the Cuyuna range in Minnesota. The first method was devised by K. M. Leute, of the General Manganese Corporation, who plans to recover a high-content manganese sinter by using hydrochloric acid to leach nodules containing 16 per cent manganese. Experimental work has been taken over by the Dorr Co. at its laboratories. Final results have not been announced. The second method was devised by Wilson Bradley to treat the high-phosphorus, high-silica, manganiferous iron ores of the Cuyuna range which thus far have not been usable; this process was recently described by Carl Zapffe,[17] as follows:

> The object of the Bradley process is to free manganese oxide from its associated gangue and separate the contained iron oxide. This results in producing two hydrated oxides as concentrates, each of excellent analysis, the one to be converted into a manganese sinter and the other into an iron sinter. The manganese sinter may be made to contain as high as 70 per cent manganese and as low as 1 per cent silica, with phosphorus not to exceed 0.02 per cent, and from that figure downward to about 0.005 per cent, and with sulphur at 0.007 per cent.
>
> As a first step, the rock is crushed and ground to pass a 65-mesh screen, the size found most effective. This product is roasted in a reducing atmosphere, using blast-furnace gas, or partly burned water gas, or producer gas, at a temperature of about 750° F. Thereby the MnO_2 in the rock is reduced to MnO and the Fe_2O_3 is reduced to Fe_3O_4 with a minimum of reduction to FeO. MnO and FeO are soluble and Fe_3O_4 is insoluble in ammonium sulphate in aqueous solution. This selective roasting is a discovery by Bradley, others having failed because of their use of higher temperatures.
>
> The leaching reaction, which constitutes the next step, changes the oxide to sulphate of manganese, with the evolution of ammonia gas, represented by this equation:
>
> $$MnO+(NH_4)_2SO_4=MnSO_4+2NH_3+H_2O$$
>
> At this stage of the process, the manganous sulphate is in solution. After clarifying the solution of any residual ore, and having captured the ammonia gas released in the reaction, the liquor and the gas are brought into contact in a standard ammonia tower and manganous hydroxide is precipitated, according to this reaction:
>
> $$MnSO_4+2NH_3+2H_2O=(NH_4)_2SO_4+Mn(OH)_2$$
>
> The manganous hydroxide is immediately treated with atmospheric air and changed to partly dehydrated manganic hydroxide, according to this reaction:
>
> $$2Mn(OH)_2+O=2MnO.OH+H_2O$$
>
> In this form the precipitate is stable and may be settled, washed, dried, and sintered.

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[15] DeVaney, F. D., and Clemmer, J. B., Flotation of Carbonate and Oxide Manganese Ores: Proc. 2d Ann. Conv. of the Am. Manganese Prod. Assoc., 1929, pp. 81–88.

[16] Nagelvoart, Adrian, Heavy-liquid Separation: Proc. 2d Ann. Conv. of the Am. Manganese Prod. Assoc., 1929, pp. 89–91.

[17] Zapffe, Carl, Leaching Manganese From the Siliceous Iron Ores of Minnesota: Eng. and Min. Jour., vol. 127, No. 26, June 29, 1929, pp. 1039–1041.

The ore to be used on the Cuyuna range [18] runs 15.00 per cent manganese, 27.50 per cent iron, 24.56 per cent silica, 2.50 per cent alumina, 1.00 per cent lime, and 8.90 per cent combined water, the analysis being made at 212° F. (dried). The resultant sinter runs 67.31 per cent manganese, 4.83 per cent iron, 2.67 per cent silica, 0.012 per cent phosphorus, 0.35 per cent alumina, 0.16 per cent magnesia, and 0.235 per cent carbon.

The Cuyuna range manganiferous ores run from 7 to 15 per cent manganese and 31 to 35 per cent iron. The Bradley process also has been applied experimentally to the ores from Las Vegas, Nev., and to certain high-silica or high-iron ores of the Appalachian region. Bradley [19] states that the method would be commercially successful, provided the price of manganese ore were higher. Generally, in the Appalachian and other ores, high in silica or iron, chemical methods are almost necessary, as these impurities are commonly in intimate association with the manganese minerals.

The United States Bureau of Mines at its Minneapolis station has devised a pyrometallurgical method [20] of utilizing the manganese content of manganiferous iron ore. The process involves three stages:

1. Smelting of manganiferous iron ore, containing 7 to 15 per cent manganese and 31 to 35 per cent iron (with high phosphorus or silica), in the blast furnace to produce a high-manganese (12 per cent manganese) pig iron.
2. Open-hearth treatment of this pig iron to produce steel and a high-manganese (55 per cent manganese) slag which can be used as an ore.
3. Conversion of the artificial ore to ferromanganese in blast or electric furnaces.

Work on the first two stages has been completed successfully and investigation of the third stage is now in progress.

Present methods for the beneficiation of carbonate ores involve selective flotation and roasting. Where rhodochrosite of comparative purity is encountered, simple roasting can be employed. The Domestic Manganese & Development Co., at Butte, Mont., roasts rhodochrosite containing 37 per cent manganese and obtains a sinter averaging 57 to 60 per cent manganese. The operations of this project, 1927 to 1929, resulted as follows:

Sinter made from rhodochrosite roasted by Domestic Manganese & Development Co., Butte, Mont., 1927–1929

Year	Rhodochrosite roasted		Sinter made		Manganese recovered from rhodochrosite (per cent)
	Long tons	Manganese (per cent)	Long tons	Manganese (per cent)	
1927	6,430	37.28	4,114	55.90	96
1928	18,595	36.63	11,118	56.45	92
1929	47,025	37.60	29,041	57.8	95
	72,050	37.32	44,273	57.3	94

When rhodochrosite contains sulphides such as galena, sphalerite, pyrite, and silicates, the simple roasting method fails to give a clean sinter. The Anaconda Copper Mining Co. has developed a selective flotation method which has proved successful on such ores in the Butte district. This commercial process is based partly on experiments[21] run by the United States Bureau of Mines at its station at Rolla, Mo. The results obtained[22] by Anaconda are summarized as follows:

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[18] Zapffe, Carl, Manganese Ore by the Bradley Process: Min. and Met., vol. 10, No. 273, pp. 428–429.

[19] Bradley, Wilson, The Bradley Process: Proc. 2d Ann. Conv. of the Am. Manganese Prod. Assoc., 1929, pp. 77–81.

[20] Joseph, T. L., Barrett, E. P., and Wood, C. E., Experiments Demonstrate Method of Producing Artificial Manganese Ore: Trans. Am. Inst. Min. and Met. Eng., Tech. Pub. 310, 1930, 29 pp.

> Testing of the rhodochrosite, by flotation, from the Emma mine of the Butte Copper & Zinc at the plant of the Anaconda Copper Mining Co., Butte, Mont., indicates that the method can be successfully applied to the ores of the Butte district. Since December, 1929, about 12,000 tons of rhodochrosite ore, averaging 30 per cent manganese and 20 per cent silica, has been treated. The concentrate averaged 38 to 40 per cent manganese and less than 6 per cent silica. The ore is now being treated at the rate of 300 tons daily and about 200 tons of concentrate is being shipped to the Domestic Manganese & Development Co. plant at Butte. This represents a recovery of about 95 per cent of the manganese content of the ore. The nodulized product averages 60 per cent manganese and 7 per cent silica.

A volatilization process has been devised by the department of mining and metallurgy of the University of Utah and the Intermountain Experiment Station of the United States Bureau of Mines for the separation of various metallic sulphides from a manganiferous iron gangue. This material contains 2.5 ounces of silver, 2.8 per cent lead, 3.7 per cent zinc, 22.8 per cent iron, 12.9 per cent manganese, and 13.8 per cent insoluble. The resultant calcines contained 33.2 per cent iron, 14.5 per cent manganese, 0.25 per cent zinc, and a trace of lead. A limestone flux and coke mixture was treated for 17 hours at a temperature of 990° C. Several tests showed favorable results, and a large tonnage of ore is available at the Utah mine. Significant[23] results are as follows:

> The objectionable zinc content of the ore was reduced from 3.7 per cent to 0.5 per cent or less, and lead was completely eliminated.
>
> A calcine was obtained which contained 33 per cent iron and 14 per cent manganese, and which was entirely satisfactory for charging into the iron blast furnace, to supply the manganese desired in the pig iron.
>
> Approximately 200 pounds of fume was recovered per ton of ore charged. This material contained 15 ounces silver per ton, 26 per cent lead, and 34 per cent zinc, and is a valuable by-product of the process.

The process and equipment used was described in the Engineering and Mining Journal, volume 129, of February 24, 1930, page 179.

Information regarding the more recent work of the Bureau of Mines in the field of the production of manganese ore or manganese from low-grade manganiferous ores is contained in the following publications:

> Report of Investigations 2902, Preliminary Ore-Dressing Tests to recover Manganese in Rhodochrosite Ores, by F. D. DeVaney and W. H. Coghill; and Report of Investigations 2936, Beneficiation of Oxidized Manganese Ores by Magnetic Separation of Roasted Jig Concentrates, by F. D. DeVaney and W. H. Coghill; Information Circular 6274, Selected Bibliography and Map of Manganese Deposits of the United States by Districts, by M. V. Healey and A. L. Johns; Flotation of Carbonate and Oxide Manganese Ores, by F. D. DeVaney and J. Bruce Clemmer; Proceedings of the Second Annual Convention of the American Manganese Producers Association, 1929, pages 81–88; Minnesota Manganiferous Iron Ore in Relation to the Iron and Steel Industry, by T. L. Joseph and

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[21] DeVaney, F. D., and Coghill, W. H., Preliminary Ore Dressing Tests to Recover Manganese in Rhodochrosite Ores: Rept. of Investigations 2902, Bureau of Mines, November, 1929, 4 pp.

[22] Engineering and Mining Journal, vol 129, No. 4, Feb. 24, 1930, p. 207.

[23] Engineering and Mining Journal, Beneficiation of Manganese Ore by Volatilization: Vol. 129, No. 8. Apr. 24, 1930, p. 414.

S. P. Kinney, Bulletin 12 of the University of Minnesota; Minnesota Manganiferous Iron Ore in Relation to the Iron and Steel Industry, by T. L. Joseph, E. P. Barrett, and C. E. Wood, Transactions of the American Institute of Mining and Metallurgical Engineers, vol. 75, 1927, pages 292–345; Production of Ferromanganese from Manganiferous Iron Ores, by T. L. Joseph, E. P. Barrett, and C. E. Wood, Proceedings of the First Annual Convention of the American Manganese Producers Association, 1928, pages 49–56; and Experiments Demonstrate Methods of Producing Artificial Manganese Ore, by T. L. Joseph, E. P. Barrett, and C. E. Wood, American Institute of Mining and Metallurgical Engineers, Technical Publication 310, 29 pages, 1930. The hydrometallurgical processes under investigation at Reno, Nev., have so far been productive of but one paper, Report of Investigations 3024, Dissolution of Various Manganese Minerals, by C. W. Davis. Further results of work are now being prepared for publication.

CONSUMPTION OF MANGANIFEROUS RAW MATERIALS IN THE MANUFACTURE OF FERROMANGANESE, SPIEGELEISEN, SILICOMANGANESE, AND MANGANIFEROUS PIG IRON IN 1929

The total quantity of manganiferous raw materials consumed in the metallurgical products manufactured in and imported into the United States in 1929 amounted to 2,266,365 long tons, with an average manganese content of 23.37 per cent, equivalent to 1,059,178 tons of 50 per cent ore. The products manufactured in the United States consumed the following materials:

	Long tons	Manganese (per cent)
Manganese ore:		
Domestic	27,685	54.82
Foreign	618,698	47.67
Ferruginous manganese ore:		
Domestic	123,809	15.08
Foreign	115,664	23.77
Manganiferous iron ore:		
Domestic	1,000,000	7.65
Foreign	50,505	6.65
Miscellaneous domestic materials	165,035	13.89
Total	2,101,396	21.85

This total is equivalent to 918,124 long tons of 50 per cent ore, of which ferromanganese took nearly 70 per cent, manganiferous pig iron nearly 23 per cent, spiegeleisen 7 per cent, and silicomanganese less than half of 1 per cent.

The manufacture of the manganese metallurgical products imported into the United States in 1929 required 164,969 long tons of material averaging 42.75 per cent manganese.

The following table shows the manganiferous raw material consumed in the manganese metallurgical products manufactured in and imported into the United States in 1929 and the equivalent of this material in terms of 50 per cent ore.

Consumption of manganiferous raw materials in ferromanganese, spiegeleisen, silicomanganese, and manganiferous pig iron manufactured in and imported into the United States in 1929

Material	Quantity consumed (long tons)	Manganese content				Equivalent in 50 per cent ore (long tons)
		Per cent	Long tons			
			Domestic	Foreign	Total	
In domestic ferromanganese:						
Manganese ore—						
Domestic	27,558	54.80	15,102	----------	15,102	30,204
Imported	614,763	47.65	----------	292,955	292,955	585,910
Ferruginous manganese ore (imported)	46,385	26.43	----------	12,260	12,260	24,520
Miscellaneous manganese-bearing materials	1,107	15.18	168	----------	168	336
	689,813	46.46	15,270	305,215	320,485	640,970
In imported ferromanganese [1]	144,816	46.46	----------	67,282	67,282	134,564
Total in ferromanganese	834,629	46.46	15,270	372,497	387,767	775,534
In domestic spiegeleisen:						
Manganese ore (domestic)	127	58.40	74	----------	74	148
Ferruginous manganese ore—						
Domestic	4,823	14.22	686	----------	686	1,372
Imported	31,003	27.94	----------	8,663	8,663	17,326
Miscellaneous manganese-bearing materials	163,928	13.88	22,755	----------	22,755	45,510
	199,881	16.10	23,515	8,663	32,178	64,356
In imported spiegeleisen [1]	20,153	16.10	----------	3,245	3,245	6,490
Total in spiegeleisen	220,034	16.10	23,515	11,908	35,423	70,846
In domestic silicomanganese: Manganese ore (imported)	3,935	50.47	----------	1,986	1,986	3,972
In domestic manganiferous pig iron:						
Ferruginous manganese ore—						
Domestic	118,986	15.12	17,987	----------	17,987	35,974
Imported	38,276	17.15	----------	6,566	6,566	13,132
Manganiferous iron ore—						
Domestic [2]	1,000,000	7.65	76,500	----------	76,500	153,000
Imported	50,505	6.65	----------	3,360	3,360	6,720
	1,207,767	8.65	94,487	9,926	104,413	208,826
Grand total	2,266,365	23.37	133,272	396,317	529,589	1,059,178

[1] Figures for ore and manganese content estimated.
[2] Figures are estimate based on incomplete returns covering 800,000 tons actually consumed.

In addition to the material shown in the foregoing table, 1,612,000 long tons of iron ore containing 2 to 5 per cent manganese was presumably used in the manufacture of manganiferous pig iron, and 45,000 to 50,000 long tons of 50 per cent manganese ore was used in the chemical industry.

The following table shows critical data on the manganese alloys imported into and produced in the United States.

Manganese alloys imported into and made from domestic and imported ores in the United States, 1923–1929, in long tons

	1923		1924		1925		1926		1927		1928		1929	
	Alloy	Manganese	Alloy	Manganese	Alloy	Manganese	Alloy	Manganese	Alloy	Manganese	Alloy	Manganese	Alloy	Manganese
Ferromanganese:														
Imported	113,833	91,066	56,588	45,270	78,713	62,970	59,710	47,768	45,500	36,400	61,055	48,844	71,211	56,969
Domestic production	251,938	196,844	211,965	165,776	259,780	205,046	318,052	252,066	294,991	232,900	319,770	251,400	339,205	269,000
From domestic ore [1]	13,070	10,008	7,352	5,600	14,910	11,592	13,495	10,541	10,037	7,472	18,850	14,036	16,428	13,056
From imported ore [1]	238,868	186,836	204,613	160,176	244,870	193,454	304,557	241,525	284,954	225,428	300,920	237,364	322,777	255,944
Total	365,771	287,910	268,553	211,046	338,493	268,016	377,762	299,834	340,491	269,300	380,825	300,244	410,416	325,969
Ratio (per cent) of manganese in ferromanganese of domestic origin to total manganese in ferromanganese made and imported	--------	3.5	--------	2.7	--------	4.3	--------	3.52	--------	2.77	--------	4.67	--------	4.01
Number of plants making ferromanganese	12	--------	11	--------	8	--------	8	--------	7	--------	7	--------	8	--------
Spiegeleisen:														
Imported	4,668	934	7,433	1,487	1,090	218	8,783	1,757	7,529	1,506	5,260	1,052	13,828	2,766
Domestic production	129,683	20,410	107,067	17,731	65,759	12,491	74,581	14,717	100,314	20,400	99,517	19,200	137,143	27,344
From domestic ore [1]	126,424	20,026	103,617	17,306	65,759	12,491	74,096	14,627	97,337	19,834	99,517	19,200	01,102	20,041
From imported ore [1]	3,259	384	3,450	425	--------	--------	485	90	2,977	566	--------	--------	36,041	7,303
Total	134,351	21,344	114,500	19,218	66,849	12,709	83,364	16,474	107,843	21,906	104,777	20,252	150,971	30,110
Ratio (per cent) of manganese in spiegeleisen of domestic origin to total manganese in spiegeleisen made and imported	--------	93.8	--------	90.1	--------	98.3	--------	88.79	--------	90.54	--------	94.81	--------	66.56
Number of plants making spiegeleisen	7	--------	6	--------	2	--------	2	--------	5	--------	4	--------	5	--------
Total available supply of metallic manganese as alloys	--------	309,254	--------	230,264	--------	280,725	--------	316,308	--------	291,206	--------	320,496	--------	356,079
Percentage of available supply of manganese in—														
Ferromanganese and spiegeleisen imported	--------	29.8	--------	20.3	--------	22.5	--------	15.66	--------	13.02	--------	15.57	--------	16.78
Ferromanganese made from imported ore	--------	60.4	--------	69.6	--------	68.9	--------	76.36	--------	77.41	--------	74.06	--------	71.88
Spiegeleisen made from imported ore	--------	.1	--------	.2	--------	--------	--------	.03	--------	.19	--------	--------	--------	2.05
Ferromanganese made from domestic ore	--------	3.2	--------	2.4	--------	4.1	--------	3.33	--------	2.57	--------	4.38	--------	3.66
Spiegeleisen made from domestic ore	--------	6.5	--------	7.5	--------	4.5	--------	4.62	--------	6.81	--------	5.99	--------	5.63
Ferromanganese and spiegeleisen made from domestic ore	--------	9.7	--------	9.9	--------	8.6	--------	7.95	--------	9.38	--------	10.37	--------	9.29
Spiegeleisen made and imported	--------	6.9	--------	8.3	--------	4.5	--------	5.21	--------	7.52	--------	6.32	--------	8.46
Total open-hearth and Bessemer steel	44,383,745	--------	37,476,940	--------	44,758,450	--------	47,626,547	--------	44,260,062	--------	50,734,151	--------	55,476,963	--------

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[1] Partly estimated.

FERROMANGANESE

In 1929 the United States consumed 614,763 long tons of foreign manganese ore (48 per cent manganese), 27,558 tons of domestic manganese ore (55 per cent manganese), 46,385 tons of foreign ferruginous manganese ore (26 per cent manganese), and 1,107 tons of miscellaneous manganese-bearing materials in the manufacture of 339,205 long tons of ferromanganese. The manganese contained in these materials was equivalent to that in 641,000 long tons of 50 per cent ore, and 95 per cent of it came from imported materials. In addition, the United States imported for consumption about 71,200 long tons of ferromanganese, the manufacture of which required the equivalent of about 135,000 long tons of 50 per cent ore. Thus, the manganese contained in materials used in the manufacture of domestic ferromanganese plus the manganese content of imported ferromanganese was equivalent to that in about 776,000 long tons of 50 per cent manganese ore, and 96 per cent of it came from foreign sources.

Ferromanganese was manufactured at the following plants in the United States in 1929:

Bethlehem Steel Co	Johnstown, Pa.
Colorado Fuel & Iron Co	Pueblo, Colo.
Lavino Furnace Co	Reusens, Va.
Ohio Ferro-Alloys Corporation	Philo, Ohio.
Pittsburgh Metallurgical Co	Niagara Falls, N. Y.
Tennessee Coal, Iron & Railroad Co	Bessemer, Ala.
United States Steel Corporation	Etna and Pittsburgh, Pa.

The following tables show the manganese ore and other metallic materials consumed and the ferromanganese produced in the United States, 1921 to 1929, and the source of the foreign manganese ore used in the manufacture of ferromanganese in the United States, 1926 to 1929.

Manganese ore and other metallic materials consumed and ferromanganese produced in the United States, 1921–1929

Year	Materials consumed (long tons)				Ferromanganese produced			Manganese ore used per ton of ferromanganese made (long tons)
	Manganese ore		Iron and manganiferous iron ores	Cinder, scale, and scrap	Long tons	Manganese contained		
	Foreign	Domestic				Per cent	Long tons	
1921	208, 376	17, 839	143	2, 092	104, 129	76. 17	79, 319	2. 172
1922	335, 165	1, 804		5, 252	150, 010	78. 55	117, 836	2. 246
1923	538, 280	26, 790	498	6, 945	251, 938	78. 13	196, 844	2. 243
1924	443, 260	20, 133	909	4, 434	211, 965	78. 21	165, 776	2. 186
1925	519, 139	34, 942	4, 949	11, 072	259, 780	78. 93	205, 046	2. 133
1926	619, 898	36, 309	8, 064	5, 122	318, 052	79. 25	252, 066	2. 063
1927	564, 725	25, 298	12, 735	8, 570	294, 991	78. 95	232, 900	2. 000
1928	566, 859	37, 827	23, 159	8, 395	319, 770	78. 62	251, 400	1. 891
1929	614, 763	27, 558	47, 735	7, 811	339, 205	79. 30	269, 000	1. 894

Foreign manganese ore used in manufacture of ferromanganese in the United States 1926–1929, in long tons

Source of ore	1926	1927	1928	1929
Africa	42, 692	41, 470	25, 039	28, 592
Brazil	237, 358	245, 485	218, 181	228, 737
Chile	5, 653	3, 746	5, 118	1, 187
Cuba	18, 372	9, 408	14, 280	2, 050
India	31, 667	78, 548	96, 232	86, 547
Porto Rico	1, 202	1, 666		
Turkey				50
Russia	282, 954	184, 402	208, 009	267, 600
	619, 898	564, 725	566, 859	614, 763

SPIEGELEISEN

In 1929 the United States consumed nearly 200,000 long tons of domestic manganese ore, domestic and imported ferruginous manganese ore, and miscellaneous manganese-bearing materials in the manufacture of 137,143 long tons of spiegeleisen (averaging 19.94 per cent metallic manganese). The manganese contained in these materials was equivalent to that in 64,356 long tons of 50 per cent ore. In addition, the United States imported for consumption about 13,800 long tons of spiegeleisen (containing about 2,800 tons of metallic manganese), the manufacture of which required the equivalent of 6,490 long tons of 50 per cent manganese ore. Thus, the total manganese content of the spiegeleisen was equivalent to that in about 71,000 long tons of 50 per cent ore.

The following plants manufactured spiegeleisen in the United States in 1929:

Colorado Fuel & Iron Co	Pueblo, Colo.
Lavino Furnace Co	Reusens, Va.
New Jersey Zinc Co	Palmerton, Pa.
United States Steel Corporation	Etna and Pittsburgh, Pa.

MANGANIFEROUS PIG IRON

Manganiferous pig-iron manufacturers in the United States in 1929 used about 1,208,000 long tons of manganiferous materials averaging 8.65 per cent manganese and including approximately 119,000 tons of domestic ferruginous manganese ore (averaging 15.12 per cent manganese), 38,300 tons of foreign ferruginous manganese ore (averaging 17.15 per cent manganese), 1,000,000 tons of domestic manganiferous iron ore (averaging 7.65 per cent manganese), and 50,500 tons of foreign manganiferous iron ore (averaging 6.65 per cent manganese). These materials contained about 104,400 long tons of metallic manganese and were equivalent to about 208,800 long tons of 50 per cent manganese ore.

In addition, shipments of iron ore containing about 2 to 5 per cent manganese amounted to 1,612,000 long tons. It is presumed that the main use of such ore was the manufacture of manganiferous pig iron, but the quantity so used in 1929 is not known.

The larger part of the manganiferous iron ore produced comes from the Cuyuna range in Minnesota, as shown in the following table:

Ferruginous manganese and manganiferous iron ore shipped from the Cuyuna district, Minnesota, 1921–1929, in long tons

Mine	Ore containing 10 to 35 per cent of manganese								
	1921	1922	1923	1924	1925	1926	1927	1928	1929
Cuyuna Mille Lacs (Louise)	------	--------	--------	12, 337	15, 896	158, 611	6, 276	[1] 3, 487	4, 129
Hillcrest	------	--------	430	--------	--------	--------	--------	--------	--------
Hopkins	------	--------	--------	6, 190	19, 929	--------	--------	--------	--------
Mahnomen	------	69, 644	74, 247	119, 781	41, 840	--------	--------	--------	--------
Mangan, Nos. 1 and 2	------	--------	--------	--------	--------	--------	--------	(1)	--------
Merritt	------	--------	[2] 24, 387	--------	--------	[3] 148	--------	--------	1, 292
Portsmouth	------	38, 000	--------	--------	--------	--------	--------	--------	--------
Sagamore	------	197, 449	154, 570	21, 607	--------	--------	--------	--------	--------
	------	305, 093	253, 634	159, 915	77, 665	158, 759	6, 276	3, 487	5, 421

Mine	Ore containing 5 to 10 per cent of manganese								
	1921	1922	1923	1924	1925	1926	1927	1928	1929
Cuyuna Mille Lacs (Louise)	------	--------	--------	9, 737	165, 142	[4] 12, 046	218, 791	205, 103	110, 308
Evergreen	------	--------	--------	--------	--------	6, 054	--------	7, 881	74, 254
Hillcrest	15, 473	4, 100	--------	--------	--------	--------	--------	--------	105, 942
Mahnomen-Sultana-Hopkins [5]	41, 057	110, 590	282, 883	128, 967	206, 155	384, 753	374, 307	340, 630	218, 887
Merritt	------	--------	--------	--------	--------	--------	--------	--------	4, 400
Milford (Ida Mae)	------	870	77, 300	--------	205, 050	202, 154	149, 034	161, 432	218, 928
Portsmouth	------	133, 000	138, 998	--------	--------	--------	--------	--------	--------
Sagamore	------	--------	--------	222, 823	165, 062	194, 451	192, 467	309, 968	271, 701
	56, 530	248, 560	499, 181	361, 527	741, 409	799, 458	934, 599	1, 025, 014	1, 004, 420

[1] Mangan included under "Cuyuna Mille Lacs (Louise)" for 1928.
[2] According to the Lake Superior Iron Ore Association.
[3] According to Skillings' Mining Review.
[4] Includes sinter.
[5] Mahnomen prior to 1926.

FERRO-ALLOYS

About 95 per cent of the manganese consumed in the United States is used in the manufacture of steel, the principal base alloys being ferromanganese and spiegeleisen. Considerable manganese is present in many varieties of steel, including spring steels, plate steels, structural bar types, rail steels, and various steels used in the manufacture of wheels, tires, axles, armor plate, etc. Formerly manganese steels containing 1 to 1.5 per cent manganese were classed as good-grade Bessemer steel, but recently they have been classified as alloy steels and have been put on the market under various trade names. Such steels have excellent tensile strength and ductility, with high resistance to abrasion, and are used extensively in caterpillar shoes, truck wheels, and other appliances where relatively low cost and high quality are required. A manganese steel containing 12 to 14 per cent manganese is used in castings for ball mills, pulverizing machinery, and rock-crusher jaws because of its resistance to impact wear and of its hardness. Manganese is also an important constituent of nickel and molybdenum steels. Molybdenum steels usually contain 0.2 to 0.4 per cent molybdenum and 1 to 1.5 per cent manganese. Nickel-manganese steel usually contains approximately 1 per cent nickel, 1 to 1.5 per cent manganese, and 0.3 to 0.4 per cent carbon. The nickel adds ductility and toughness but increases the cost.

A new series of alloy steels containing 18 per cent chromium and 7 to 10 per cent manganese has been described recently by Beckett.[24]

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[24] Beckett, F. M., Chromium-Manganese Steels: Am. Metal Market, vol. 37, No. 116, June 17, 1930, p. 10.

Laboratory tests indicate that these steels have many favorable properties and may soon be of commercial importance.

PRODUCTION OF FERROMANGANESE AND SPIEGELEISEN

During 1929, 334,162 long tons of ferromanganese and 123,146 tons of spiegeleisen were shipped from furnaces in the United States, compared with 310,122 tons of ferromanganese and 116,911 tons of spiegeleisen in 1928. Both production and shipments of ferromanganese in 1929 constituted an all-time record. The record year for production of spiegeleisen was 1918.

The following table shows the shipments of ferromanganese and spiegeleisen from domestic furnaces, 1920 to 1929.

Ferromanganese and spiegeleisen shipped from furnaces in the United States, 1920–1929

Year	Ferromanganese		Spiegeleisen	
	Long tons	Value	Long tons	Value
1920	[1] 276,594	$41,840,690	103,672	$5,289,049
1921	[1] 111,374	13,654,800	[2] 69,230	2,838,692
1922	[1] 161,612	10,673,638	70,253	2,162,836
1923	226,365	23,853,313	134,086	4,547,113
1924	[1] 232,821	23,533,668	76,179	2,354,731
1925	[1] 254,005	26,006,439	95,890	2,407,226
1926	330,070	31,711,871	82,982	2,016,088
1927	291,056	27,243,489	80,892	1,986,188
1928	310,122	29,199,990	116,911	2,802,108
1929	334,162	33,184,012	123,146	3,336,703

[1] Includes a small quantity of silicomanganese.

[2] Includes a small quantity of silicospiegel.

IMPORTS AND EXPORTS OF FERROMANGANESE AND SPIEGELEISEN

Imports.—Ferromanganese imported for consumption in 1929 contained 56,969 long tons of metallic manganese, compared with 48,844 tons in 1928 and 36,400 tons in 1927. Imports of spiegeleisen in 1929 increased 163 per cent over 1928. These increases in 1929 were coincident with important increases in domestic production.

The following table shows the ferromanganese and spiegeleisen imported for consumption in the United States from 1920 to 1929.

Ferromanganese and spiegeleisen imported for consumption in the United States, 1920–1929

Year	Ferromanganese		Spiegeleisen	
	Long tons	Value	Long tons	Value
1920	59,254	$7,775,278	5,234	$277,900
1921	9,077	888,419	307	10,472
1922 Jan. 1-Sept. 21	72,136	6,125,469	3,899	268,135
1922 Sept. 22-Dec. 31	[1] 22,871		4,252	
1923	[1] 91,066	8,357,023	4,668	165,791
1924	[1] 45,270	3,844,474	7,433	235,566
1925	[1] 62,970	6,033,147	1,090	39,841
1926	[1] 47,768	4,410,142	8,783	256,714
1927	[1] 36,400	3,553,465	7,529	220,979
1928	[1] 48,844	4,899,374	5,260	147,406
1929	[1] 56,969	6,126,056	13,828	403,853

[1] Figures prior to Sept. 22, 1922, represent gross weight of the ferromanganese, but since that date represent the manganese content only.

The "general" imports of ferromanganese into the United States contained 62,785 long tons of metallic manganese in 1929, compared with 47,550 tons of metallic manganese in 1928. The Bureau of Mines estimates that the gross weight of the ferromanganese imported was 78,481 long tons in 1929, compared with 59,438 tons in 1928. These totals indicate an increase of about 32 per cent in both gross weight of ferromanganese and metallic manganese content. Of the total imports Canada supplied 44 per cent in 1929, Norway 30 per cent, and Great Britain 22 per cent, a total of 96 per cent for the three countries, compared with 40 per cent for Canada, 33 per cent for Great Britain, and 25 per cent for Norway, a total of 98 per cent, in 1928. Imports from Canada and Norway increased 44.4 and 57.6 per cent, respectively, due to the cheaper hydroelectric power available for electric furnaces in those countries, whereas imports from Great Britain decreased 11.4 per cent. The following table shows the imports of ferromanganese in 1928 and 1929, by countries.

Ferromanganese imported into the United States, 1928 and 1929, by countries

[General imports]

Country	1928		1929	
	Manganese content (long tons)	Value	Manganese content (long tons)	Value
Canada	19,026	$2,495,743	27,474	$3,593,981
France	384	63,777	516	73,929
Germany	23	3,477	100	6,713
Italy	611	95,492	2,096	330,480
Norway	11,896	934,793	18,743	1,702,579
Sweden	43	5,073	71	8,599
United Kingdom	15,567	1,207,830	13,785	1,100,965
	47,550	4,806,185	62,785	6,817,246

The increase in 1929 in bonded warehouse stocks of ferromanganese is estimated by the Bureau of Mines as approximately 7,400 long tons, practically balancing the difference between general imports and imports for consumption. The general imports of ferromanganese in 1929 represented about 145,000 tons of 50 per cent manganese ore, and imports for consumption were equivalent to about 135,000 tons of 50 per cent ore.

The following table shows the manganese content of the ferromanganese imported into the United States in 1928 and 1929, by ports of entry.

Manganese content of ferromanganese imported into the United States, 1928 and 1929, by ports of entry, in long tons

[General imports]

Port of entry	1928	1929
Buffalo	9,548	18,486
Galveston	49	59
Los Angeles	1,759	1,925
Maryland	14,416	17,561
Michigan	6,551	6,988
New Orleans	6,838	10,103
New York	926	2,486
Ohio	2,950	2,000
Philadelphia	1,707	254
San Francisco	1,808	2,362
Washington (State)	998	561
	47,550	62,785

The following table shows the production and imports of ferromanganese and manganese ore during the last eight years and the duties collected on the imported material.

Ferromanganese and manganese ore produced in and imported into the United States under the tariff act of 1922, in long tons

Year	Ferromanganese			Manganese ore		
	Domestic shipments	Imports	Duty collected [1]	Domestic shipments	Imports	Duty collected [1]
1922	161,612	[2] 100,725	[3] $962,037.45	13,404	[2] 425,000	[3] $405,977.60
1923	226,365	[2] 113,833	3,834,392.70	31,500	[2] 419,000	1,659,638.40
1924	232,821	[2] 56,588	1,905,643.65	56,515	[2] 505,000	4,780,832.00
1925	254,005	[2] 78,713	2,652,841.80	98,324	[2] 615,000	6,078,352.00
1926	330,070	[2] 59,710	1,822,746.00	46,258	[2] 738,000	7,935,729.60
1927	291,056	[2] 45,500	1,526,508.60	44,741	622,067	6,723,964.80
1928	310,122	[2] 61,055	2,056,776.90	46,860	427,708	6,006,694.40
1929	334,162	[2] 71,211	2,416,751.85	60,379	664,269	7,086,262.40

[1] Represents duty collected on withdrawals from warehouse and on imports for immediate consumption.

[2] From Sept. 22, 1922, to Dec. 31, 1926, the Bureau of Foreign and Domestic Commerce reported only the manganese content of ferromanganese and manganese ore imported; since 1927 the bureau has reported the gross weight of the ore but only the manganese content of the ferromanganese. This figure is a Bureau of Mines estimate of the gross weight of ore or alloy imported.

[3] Tariff became effective Sept. 22, 1922; shipments and imports cover entire year.

Exports.—The following table shows the exports of ferromanganese and spiegeleisen from the United States from 1920 to 1929.

Ferromanganese and spiegeleisen exported from the United States, 1920–1929

Year	Long tons	Value	Year	Long tons	Value
1920	3,454	$642,570	1925	5,496	$160,568
1921	690	100,474	1926	693	44,111
1922	[1] 1,396	[1] 84,562	1927	1,641	61,793
1923	4,295	151,224	1928	9,440	232,990
1924	3,165	92,421	1929	1,574	59,036

[1] Composed of 1,107 tons of ferromanganese, valued at $76,822, and 289 tons of spiegeleisen, valued at $7,740; not separately classified for other years.

PRICES OF FERROMANGANESE AND SPIEGELEISEN

Contract prices for ferromanganese in 1929 averaged higher than in 1928 and, according to Iron Age, held at $105 duty paid at tidewater. According to the Iron Trade Review, the price remained constant at $109.79 until December, when it dropped to $104.79. During 1928 the price fluctuated from $104.79 in January to a high of $109.79 in December.

According to the Iron Trade Review, spiegeleisen was active in 1929. Prices on domestic material held at $34, furnace, per carload lot throughout the year, except during August and September when prices were $33.20 and $33.50, respectively. This price was reaffirmed for the first six months of 1930, subject as usual to differentials on larger quantities. Record shipments were made throughout the major part of 1929. English spiegeleisen, generally of higher manganese content than domestic, was sold in moderate volume.

The following table shows the quoted prices of ferromanganese, spiegeleisen, and manganese ore from 1924 to 1929.

Prices per long ton of ferromanganese, spiegeleisen, and manganese ore in the United States, 1924–1929 [1]

Month	Ferromanganese (80 per cent) (delivered at Pittsburgh) [2]					
	1924	1925	1926	1927	1928	1929
January	$113.79	$116.79	$119.79	$104.79	$104.79	$109.79
February	112.29	119.79	119.79	104.79	104.79	109.79
March	112.29	119.79	102.29	104.79	104.79	109.79
April	112.29	119.79	92.79	104.79	104.79	109.79
May	112.29	119.79	92.79	98.54	108.19	109.79
June	112.29	119.79	92.79	94.79	109.79	109.79
July	110.79	119.79	92.79	94.79	109.79	109.79
August	98.79	119.79	92.79	94.79	109.79	109.79
September	97.79	119.79	92.79	94.79	109.79	109.79
October	104.79	119.79	99.79	94.79	109.79	109.79
November	107.29	119.79	104.79	94.79	109.79	109.79
December	109.79	119.79	104.79	103.42	109.79	104.79

Month	Spiegeleisen (20 per cent) (at producers' furnaces)					
	1924	1925	1926	1927	1928	1929
January	$39.00	$32.00	$34.00	$37.00	$32.00	$34.00
February	39.00	33.00	34.00	37.00	32.00	34.00
March	38 00	33.00	34.00	37.00	32.00	34.00
April	36.00	33.00	34.00	37.00	32.00	34.00
May	36.75	33.00	34.00	35.50	32.00	34.00
June	36.00	32.00	34.00	34.80	32.00	34.00
July	35.00	31.50	34.00	34.00	33.00	34.00
August	32.50	32.25	34.00	33.35	33.00	33.20
September	32.00	33.00	34.00	33.00	33.00	33.50
October	31.00	33.00	34.00	30.15	33.00	34.00
November	31.75	34.00	38.75	30.00	33.00	34.00
December	31.00	34.00	37.00	31.00	34.00	34.00

Month	Manganese ore (50 per cent) (duty paid, North Atlantic ports) [3]					
	1924	1925	1926	1927	1928	1929
January	$31.20	$32.20	$30.70	$30.70	$30.20	$27.70
February	32.70	32.70	30.70	30.70	30.20	27.70
March	32.20	33.20	30.70	30.70	30.20	27.70
April	32.20	33.20	30.70	30.70	30.20	27.70
May	32.20	32.70	30.70	30.70	30.20	27.70
June	31.70	32.20	30.70	30.70	30.20	27.70
July	30.70	32.20	30.70	30.70	30.20	26.70
August	30.20	32.20	30.70	30.70	30.20	26.70
September	30.20	31.70	30.70	30.70	30.20	26.70
October	30.20	31.70	30.70	30.70	30.20	25.70
November	31.70	31.70	30.70	30.70	29.20	25.70
December	32.20	31.70	30.70	30.70	29.20	25.70

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[1] Iron Trade Review.

[2] Beginning with Sept. 22, 1922, a duty of 1⅞ cents a pound of contained manganese was placed on ferromanganese imports.

[3] Beginning with Sept. 22, 1922, a duty of 1 cent a pound was placed on the metallic content of imported manganese ore. This amounts to $11.20 a ton on 50 per cent ore.

The London price of ferromanganese decreased from £13 15s. in January to £12 10s. in December. All of this decrease took place after August, when Russian price cutting began to depress the market seriously. The German price remained at £15 in 1929, the same as quoted in 1928.

The following table shows the London quoted prices for ferromanganese during 1928 and 1929, by months.

London quoted prices per long ton of ferromanganese, 1928 and 1929 [1]

Month	Home price f. o. b. plant						Export price f. o. b. plant						Export price c. i. f. Atlantic seaboard					
	1928			1929			1928			1929			1928			1929		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
January	13	10	0	13	15	0	13	0	0	14	10	0	20	10	0	21	13	0
February	13	10	0	13	15	0	13	0	0	14	10	0	20	10	0	21	13	0
March	13	10	0	13	15	0	13	5	0	14	6	0	20	10	0	21	13	0
April	13	10	0	13	15	0	13	5	0	14	0	0	20	10	0	21	13	0
May	13	10	0	13	15	0	13	5	0	14	0	0	20	10	0	21	13	0
June	13	10	0	13	15	0	13	5	0	14	0	0	21	10	0	21	13	0
July	13	15	0	13	15	0	13	7	6	14	0	0	21	10	0	21	13	0
August	13	15	0	13	15	0	13	10	0	14	0	0	21	10	0	21	13	0
September	13	15	0	13	12	6	14	10	0	13	17	6	21	14	0	21	13	0
October	13	15	0	13	10	0	14	10	0	13	15	0	21	14	0	21	13	0
November	13	15	0	13	2	0	14	10	0	13	7	0	21	13	3	21	13	0
December	13	15	0	12	10	0	14	10	0	13	0	0	21	13	0	21	11	9

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[1] Iron and Coal Trades Review, weekly quotations.

The British spiegeleisen contract price was £7 10s. ($36.45) at the beginning of 1929 and remained steady until October 11, when a slight drop to £7 5s. ($35.24) took place; this price continued to the end of the year, except for a short period in November when the price was higher.

MANGANIFEROUS ZINC RESIDUUM

Manganiferous residuum, from zinc roasting in the United States, shipped in 1920–1929, in long tons

1920	133, 602	1925	147, 937
1921	12, 627	1926	179, 926
1922	81, 333	1927	184, 771
1923	132, 801	1928	171, 107
1924	119, 457	1929	168, 363

MANGANIFEROUS SILVER ORE

Manganiferous silver ore shipped from mines in the United States, 1920–1929, in long tons [1]

Year	Arizona	Colorado		Montana	Nevada	New Mexico
		For fluxing	For other purposes			
1920	345	34, 670	11, 056	----------	95, 142	541
1921	----------	10, 819	924	----------	14, 871	300
1922	----------	13, 951	----------	6, 656	----------	8, 764
1923	----------	10, 376	18, 348	3, 596	28, 571	----------
1924	----------	4, 488	30, 949	5, 607	16, 710	----------
1925	----------	11, 366	7, 352	----------	16, 168	----------
1926	----------	6, 656	2, 925	----------	11, 051	----------
1927	----------	1, 029	26, 828	----------	2, 161	----------
1928	----------	48	18, 516	----------	1, 602	----------
1929	----------	----------	17, 770	----------	----------	----------

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[1] All used for fluxing except that from Colorado designated "For other purposes."

TARIFF

The tariff act of 1930 became effective on June 18, 1930. The change in the manganese schedules was the extension of the duty to include ore containing 10 to 30 per cent manganese which previously had been admitted free. The clause covering manganese ore is as follows:

> Par. 302: (*a*) Manganese ore (including ferruginous manganese ore) or concentrates, and manganiferous iron ore, all of the foregoing containing in excess of 10 per centum of metallic manganese, 1 cent per pound on the metallic manganese contained therein.

The 1922 tariff bill provided:

> Par. 302: Manganese ore or concentrates containing in excess of 30 per cent of metallic manganese, 1 cent per pound on the metallic content therein.

The rate on ferromanganese was unchanged in the tariff bill of 1930. The new schedules are as follows:

> Par. 302: (*d*) Ferromanganese containing more than 1 per centum of carbon, 1⅞ cents per pound on the metallic manganese contained therein: *Provided*, That ferromanganese for the purposes of the act shall be such manganese alloys as contain 30 per centum or more of manganese.
>
> (*e*) Manganese metal, manganese silicon, manganese boron, and ferromanganese and spiegeleisen containing not more than 1 per centum of carbon, 1⅞ cents per pound on the manganese contained therein and 15 per centum ad valorem.

WORLD ASPECTS

During the latter half of 1929 the manganese market appeared to be in a depressed condition, notwithstanding the fact that consuming countries were increasing their imports. Prices were adversely affected by overproduction. The condition of the market as of June, 1930, was summarized by D. P. Lloyd, a member of the staff of the minerals division of the Bureau of Foreign and Domestic Commerce, as follows:[25]

> Among the factors which have led to this situation none has been discussed so frequently as the influence of Russian production and Soviet policy. According to official Union of Socialist Soviet Republics statistics, exports from Russia during the fiscal year ended September 30, 1929, were 900,000 tons, compared with 499,000 tons in the preceding year, and every effort is being made to increase exports similarly this year. The natural effect upon a market of such a large increase in supplies is obvious, but the result has been doubly depressing owing to the determination of the Soviet to control the world market by effecting sales at any price. The result has been disastrous to many of the producing mines in other countries, some of which have been forced to close down, while others are able to survive only by practising the greatest of economies. In India the situation was met by the introduction of more modern machinery in order to increase the efficiency of the mines.

Improvements have been made at Takoradi Harbor in Gold Coast, where exports in 1929 increased in spite of Russian competition. It is reported from Accra that, given good market conditions, shipments from Gold Coast will increase in 1930. Exports in 1929 amounted to 408,224 long tons of high-grade concentrates.

The two new fields of importance, Bou Arfa in Morocco and Postmasburg in the Union of South Africa, continued their development-work programs. The Bou Arfa reserves are said to be large and high grade, and this deposit is the most favorably located of the Moroccan deposits with respect to transportation to the European consuming centers. According to British sources[26] the development program at Bou Arfa has been held back somewhat by the general world price depression.

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[25] Lloyd, D. P., International Trade in Manganese Ore: First Quarter of 1930, Commerce Rept. No. 22, June 2, 1930, pp. 565–567.

Postmasburg continues to develop, and it is believed that the new railway will be hauling ore during the second half of 1930. In the meantime, plant equipment has been set up. A considerable force is actively engaged in mining and stocking ore for shipment at the first opportunity. Some doubt has been expressed as to whether the Postmasburg operators can withstand the poor market conditions, which at present seem inevitable, when the output is placed on sale. However, the chairman of the Manganese Corporation (Ltd.) voices a more optimistic view of the chances of the company to meet foreign competition. He states:[27]

> We are in no way affected by the general depression which is in evidence of late. We went into this enterprise when prices for manganese ores had already fallen, with the position clearly before us that we had excellent ores to exploit and that we had to take the market as we found it and by careful working in every direction, made the best of it. Forward contracts were entered into for our anticipated output at prices which are satisfactory to all parties, including ourselves. Our consumers will be getting a good article at a reasonable price, as the market goes even now. Our chief competitors are the Russians, who are busy cutting prices against us, but without affecting our market.

It appears also that this company has obtained favorable ocean rates by agreeing to withhold shipments until slack periods, and in order to adjust deliveries warehouses have been constructed at Durban to accommodate about 50,000 tons of ore.

American interests have become associated with the development of the Makri deposits in Turkey, and production is expected in 1930.

There has been a definite decrease in Brazilian production, but further curtailment is unlikely, as some of the mines in Brazil are now owned by American companies which are large consumers.

The minor producing areas held their own, generally. American production increased, due largely to the Montana output. Considerable interest was evidenced in the deposits of Chile, Cuba, Canada, and other countries. Javan deposits continued to produce. China sent much of its production (40,000 to 50,000 tons) to Japan, which country enjoys a favorable position compared with other purchasers of manganese ore because of the low rate of exchange there.

The building up of consumers' and producers' stocks, coupled with reduced steel outputs in the main industrial countries due to the general economic depression, may appreciably add to the quietness of market conditions and assure a buyers' market for 1930. It seems probable that with contracts let for the first six months of 1930, market conditions for spot deliveries will be none too favorable.

That attempts to form a producers' cartel have failed is attributed in some quarters to the tendency of the Soviet Government to remain apart. This view is expressed in the following quotation taken from the Mining Journal (London):[28]

> Evidently a number of attempts have been made to bring the world producers together in conference with the objective in view of establishing a world price at which all the main producers could operate successfully. Thus far, however, the Russians have tended to avoid such a proposal, and until they can be brought

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[26] Metal Bulletin, No. 1464, January 28, 1930.

[27] South African Mining and Engineering Journal, The Outlook for Our Manganese Ore: Vol. 41, Pt. 1, No. 2021, June 21, 1930, pp. 467–468.

[28] Mining Journal (London), vol. 168, No. 4927, Jan. 25, 1930, p. 18.

around, no success can be had. The cheap production costs and short land transportation enjoyed by the Russian fields gives them a favorable economic position which is hard to match by other producing centers other than Gold Coast. Thus far the participation of Russia in such a cartel is extremely dubious.

The principal importing and exporting countries are as follows:

Manganese ore imported into principal importing countries, 1928 and 1929, in long tons

Country	1928	1929
France	727, 000	788, 000
United States	428, 000	664, 000
Germany	280, 000	384, 000
Belgium and Luxemburg	263, 000	324, 000
United Kingdom	206, 000	289, 000
Italy	65, 000	[1] 92, 000
Norway	149, 000	[2] 150, 000
	2, 118, 000	2, 691, 000

[1] Estimate based on first 6 months. [2] Estimate based on imports in 1928.

Manganese ore exported from the principal producing countries, 1928 and 1929, in long tons

Country	1928	1929
Brazil	356, 000	289, 000
Russia	491, 000	886, 000
China	43, 000	42, 000
Gold Coast	[1] 328, 000	[1] 408, 000
India	834, 000	964, 000
	2, 052, 000	2, 589, 000

[1] Concentrates.

The United States and other consuming countries imported large quantities of ferruginous manganese ore and manganiferous iron ore from Spain, Greece, North Africa, India, Egypt (Sinai Peninsula), Australia, and Brazil. Such ores are now used for the manufacture of spiegeleisen and manganiferous pig iron and for mixing with high-grade ore in the manufacture of ferromanganese.

FOREIGN RESOURCES

GENERAL STATEMENT

The world production of manganese ore in 1929 was about 3,405,000 long tons, compared with about 2,555,000 tons in 1928, 3,045,000 tons in 1927, and 3,040,000 tons in 1926. During 1929, Russia produced 35 per cent of the world total; India, 29 per cent; Gold Coast, 13 per cent; Brazil, 9 per cent; and Egypt (Sinai Peninsula), 6 per cent—a total of 92 per cent for these five countries. Of the 1928 output, British India produced 38.3 per cent; Russia, 19.2 per cent; Brazil, 13.9 per cent; Gold Coast, 13.4 per cent; and Egypt, 5.3 per cent—a total of 90.1 per cent. In 1927 the countries ranked as follows: India, 37 per cent of the total; Russia, 27 per cent; Gold Coast, 13 per cent; Brazil, 9 per cent; Egypt, 5 per cent; United States, 1.5 per cent; China, 1.5 per cent; and other countries, 6 per cent.

Comparing 1929 with 1928, the output in Russia, Gold Coast, and India increased 141, 33, and 2 per cent, respectively, whereas a decrease of 12 per cent was recorded for Brazil.

Manganese ore produced in the principal countries, 1925–1929, in metric tons

[Prepared by L. M. Jones, of the Bureau of Mines]

Country [1]	Percentage of manganese	1925	1926	1927	1928	1929
North America:						
Canada (shipments)	----------	----------	----------	----------	349	273
Cuba	36–48	51, 638	28, 091	812	2, 440	972
Mexico	40+	3, 333	3, 299	861	661	249
United States—						
Continental (exclusive of fluxing ore)	35+	99, 902	47, 000	45, 459	47, 612	61, 348
Porto Rico [2]	35+	4, 260	1, 440	1, 650	1, 547	2, 353
South America:						
Argentina [3]	----------	----------	140	230	141	208
Brazil	38–50	331, 827	260, 536	273, 494	359, 651	316, 172
Chile	40–50	11, 062	11, 134	7, 688	9, 192	(4)
Uruguay [2]	----------	----------	39	----------	----------	(4)
Europe:						
Bulgaria	30–45	565	490	7	----------	----------
Germany	30+	144	25	30	210	475
Great Britain	30+	842	130	1, 048	239	----------
Greece	30+	4, 303	6, 348	8, 283	1, 080	(4)
Hungary	30	3, 100	9, 909	17, 272	22, 167	19, 044
Italy	30–50	14, 984	14, 010	9, 764	10, 274	9, 917
Portugal	38–60	[2] 11	----------	491	----------	----------
Rumania	42	5, 368	8, 353	10, 369	31, 267	35, 038
Russia [5]	41–48	676, 502	1, 028, 607	843, 850	498, 800	1, 200, 000
Spain	29+	36, 072	44, 947	36, 870	13, 704	17, 872
Sweden	45+	10, 941	15, 258	16, 823	15, 790	14, 609
Yugoslavia	42–45	2, 716	1, 244	1, 971	2, 660	3, 072
Asia:						
China [2]	50–55	43, 260	42, 460	46, 350	43, 332	42, 468
Cyprus	----------	----------	----------	16	83	----------
India—						
British	47–52	852, 934	1, 031, 218	1, 147, 479	994, 153	1, 010, 237
Portuguese [2]	42–46	(4)	3, 089	2, 414	4, 164	4, 948
Japan	50+	12, 040	15, 209	27, 560	17, 693	18, 446
Netherland East Indies	45–56	10, 997	11, 393	18, 503	24, 452	20, 997
Portuguese East Indies (Timor)	----------	----------	----------	----------	----------	3, 300
Turkey	----------	98	77	----------	61	150
Africa:						
Algeria [2]	----------	450	577	3, 817	1, 476	436
Egypt	30+	80, 589	121, 868	152, 845	137, 502	191, 477
Gold Coast [2]	50+	362, 897	377, 284	409, 658	348, 755	465, 282
Morocco (French) [2]	50	679	306	2, 696	2, 144	239
Northern Rhodesia	41–50	----------	----------	705	1, 821	1, 879
Tunisia	30–43	1, 655	1, 550	2, 056	2, 200	200
Union of South Africa	40–60	471	835	1, 300	----------	9, 349
Oceania:						
Australia—						
New South Wales	----------	1, 183	1, 311	1, 221	170	237
Queensland	50±	----------	20	246	----------	----------
Victoria	50±	----------	----------	15	----------	----------
Western Australia [2]	47+	----------	83	30	----------	81
New Caledonia [2]	----------	10	----------	130	(4)	(4)
New Zealand [2]	52+	----------	----------	5	----------	----------
	----------	2, 628, 000	3, 088, 000	3, 094, 000	2, 596, 000	3, 460, 000

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[1] In addition to the countries listed, Belgium and Madagascar are reported to produce small quantities of manganese, but statistics of output are not available. Czechoslovakia and France report a production of "manganese ore," but as it has been ascertained that the product so reported averages a content of less than 30 per cent manganese and therefore would be considered ferruginous manganese ore under the classification used in this report the output has not been included in the table.

[2] Exports.

[3] Shipments by rail and river.

[4] Data not available.

[5] Year ended Sept. 30.

Manganese ore produced in the principal countries, 1925–1929, in long tons

[Prepared by L. M. Jones, of the Bureau of Mines]

Country [1]	Percentage of manganese	1925	1926	1927	1928	1929
North America:						
Canada (shipments)	----------	----------	----------	----------	344	269
Cuba	36–48	50,823	27,647	799	2,401	957
Mexico	40+	3,280	3,247	847	651	245
United States—						
Continental (exclusive of fluxing ore)	35+	98,324	46,258	44,741	46,860	60,379
Porto Rico [2]	35+	4,193	1,417	1,624	1,523	2,316
South America:						
Argentina [3]	----------	----------	138	226	139	205
Brazil	38–50	326,585	256,420	269,174	353,970	311,178
Chile	40–50	10,887	10,958	7,567	9,047	(4)
Uruguay [2]	----------	----------	38	----------	----------	(4)
Europe:						
Bulgaria	30–45	556	482	7	----------	----------
Germany	30+	142	25	30	207	467
Great Britain	30+	829	128	1,031	235	----------
Greece	30+	4,235	6,248	8,152	1,063	(4)
Hungary	30	3,051	9,753	16,999	21,817	18,743
Italy	30–50	14,747	13,789	9,610	10,112	9,760
Portugal	38–60	[2] 11	----------	483	----------	----------
Rumania	42	5,283	8,221	10,205	30,773	34,485
Russia [5]	41–48	665,820	1,012,365	830,526	490,900	1,180,000
Spain	29+	35,502	44,237	36,288	13,488	17,590
Sweden	45+	10,768	15,017	16,557	15,541	14,378
Yugoslavia	42–45	2,673	1,224	1,940	2,618	3,023
Asia:						
China [2]	50–55	42,577	41,790	45,619	42,648	41,797
Cyprus	----------	----------	----------	16	82	----------
India—						
British	47–52	839,461	1,014,928	1,129,353	978,449	994,279
Portuguese [2]	42–46	(4)	3,040	2,376	4,098	4,870
Japan	50+	11,850	14,969	27,124	17,413	18,155
Netherland East Indies	45–56	10,823	11,213	18,211	24,066	20,665
Portuguese East Indies (Timor)	----------	----------	----------	----------	----------	3,200
Turkey	----------	96	76	----------	60	148
Africa:						
Algeria [2]	----------	443	568	3,757	1,453	443
Egypt	30+	79,316	119,944	150,432	135,331	188,454
Gold Coast [2]	50+	357,165	371,324	403,187	343,246	457,932
Morocco (French) [2]	50	668	301	2,653	2,110	235
Northern Rhodesia	41–50	----------	----------	694	1,792	1,849
Tunisia	30–43	1,629	1,526	2,024	2,165	197
Union of South Africa	40–60	463	821	1,279	----------	9,202
Oceania:						
Australia—						
New South Wales	----------	1,164	1,290	1,202	167	233
Queensland	50±	----------	20	242	----------	----------
Victoria	50±	----------	----------	15	----------	----------
Western Australia [2]	47+	----------	82	30	----------	80
New Caledonia [2]	----------	10	----------	128	(4)	(4)
New Zealand [2]	52+	----------	----------	5	----------	----------
	----------	2,586,000	3,040,000	3,045,000	2,555,000	3,405,000

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[1] In addition to the countries listed, Belgium and Madagascar are reported to produce small quantities of manganese, but statistics of annual output are not available. Czechoslovakia and France report a production of "manganese ore," but as it has been ascertained that the product so reported averages a content of less than 30 per cent manganese and therefore would be considered ferruginous manganese ore under the classification used in this report the output has not been included in the table.

[2] Exports.

[3] Shipments by rail or river.

[4] Data not available.

[5] Year ended Sept. 30.

NORTH AMERICA

CANADA

Canada shipped 269 long tons (301 short tons) of manganese ore in 1929, compared with 344 long tons (385 short tons) in 1928.

A mine[29] at New Ross, which closed in 1917, is to be reopened early in 1930, and by September a monthly production of 1,000 long tons is expected. Most of this ore is to be sent to the United States.

During 1928[30] a bog-manganese deposit at Dawson Settlement, near Hillsborough, New Brunswick, shipped 385 short tons of ore worth $2,237. This material was shipped to the Province of Quebec for use as a coloring agent in brick. A new deposit[31] has been reported in the vicinity of Turtle Creek, near Hillsborough, New Brunswick. The ore is said to run 87 to 90 per cent manganese dioxide, and the reserves are said to be about 750,000 tons. Plans call for the development of the deposit early in 1930, and the nearness of the ore to the surface indicates that mining should not be costly.

The Canadian Mining Journal[32] makes the following statement regarding manganese deposits in Canada:

> In this country only small deposits of manganese ore have been found up to the present. A few thousand tons have been won from veins in Nova Scotia, New Brunswick, and British Columbia. The great bedded deposits that yield most of the world's supply have not yet been found in this country. There are suggestions of such deposits in the limestones of Cape Breton where schooner loads of high-grade ore have been collected from fields along the shores of the Bras d'Or Lakes from time to time. These blocks of ore are evidently an insoluble residence from limestone, in which they occur as local segregations. No systematic prospecting has been conducted to find whether or not this manganese-bearing horizon contains consistent beds of ore, in Cape Breton or on the mainland of Nova Scotia, so it is just possible that payable deposits may be found there in course of time.

CUBA

Practically all of the manganese mined in Cuba is from mines in Oriente Province, the most important of which are La Gloria (San Luis district), Cristo Panupo, San Nicolas, Palmarito, Los Negros, Santa Rita, Guisa, Sabanilla, and South Coast. Other deposits are recorded in the Provinces of Pinar del Rio, Matanzas, and Santa Clara. These mines produced a considerable tonnage during the World War, practically all of which was exported to the United States.

In 1918 it was estimated[33] that there were 700,000 to 800,000 tons of material, carrying more than 36 per cent manganese, in Cuba. Recent estimates indicate a reserve of more than 1,000,000 tons of ore.

The metallurgical ore mines[34] were leased by Mr. Pitts in 1927 to an American company of New York. (Howard Trumbo was the local manager of the firm.) These are believed to be the only deposits of metallurgical ore in Cuba and test from 57 to 59 per cent manganese. Operations began in 1927 and shipments were made in 1928. A cableway was installed to transport ore directly from the mine workings to steamships.

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[29] Foreign Trade Notes, No. 281, Feb. 26, 1930, p. 8.

[30] Dominion Bureau of Statistics, Canada, Press Release, Oct. 16, 1929, p. 1.

[31] Bennan, Earl, vice consul, Moncton, New Brunswick, Consular Rept. 332,176, Mar. 27, 1930.

[32] Canadian Mining Journal, vol. 51, No. 6, Feb. 7, 1930, p. 127.

[33] Stewart, J. B., Cuban Manganese in 1918: Eng. and Min. Jour., vol. 107, p. 196, 1919.

[34] Nathan, E. I., consul, Mineral Production during 1927 in the Santiago de Cuba Consular District, Province of Oriente: May 24, 1928.

No further information has been published on the development of the Pew property, although it is reported that negotiations are under way for the sale of the mines.

Production of manganese ore in Cuba during the 5-year period, 1925 to 1929, was as follows:

	Long tons
1925	50, 823
1926	27, 647
1927	799
1928	2, 401
1929	957

This ore averaged between 36 and 48 per cent manganese. Thus far the development of the Cuban manganese ore industry has been hindered by inadequate transportation facilities. The new east-west highway system should help to remedy this condition.

SOUTH AMERICA

BRAZIL

According to semiofficial statistics, Brazil exported 293,318 metric tons in 1929, as compared with 361,829 tons in 1928. Shipments to various countries in 1929 were as follows: United States, 77 per cent of the total; France, 11 per cent; Belgium, 10 per cent; and others, 2 per cent.

Stocks at shipping points on December 31, 1929, were 44,800 metric tons and on December 31, 1928, they were 45,500 tons.

The principal producers in 1929 were Cia Meridional de Mineração, Santa Mathilde, and A. Thun & Co. (Ltd.). The South American Manganese Co. (Ltd.) reported steady progress in prospecting. Preliminary development indicated ore of 51 to 54 per cent manganese content. Few new developments took place in the Brazilian manganese industry during 1929.

CHILE

Imports of manganese ore into the United States from Chile amounted to 2,000 long tons in 1929, compared with 9,340 tons in 1928. This ore came from the Las Cañas district in Coquimbo Province and probably contained about 44 to 47 per cent manganese.

EUROPE

BELGIUM AND LUXEMBURG

Imports [35] of manganese ore into Belgium and Luxemburg in 1928 and 1929 are shown in the following table:

Manganese ore imported into Belgium and Luxemburg, 1928 and 1929, by countries, in metric tons

Country	1928	1929
Brazil	38, 400	18, 600
India:		
British	125, 000	152, 300
Portuguese	12, 800	19, 600
Russia	69, 300	89, 000
Other countries	21, 700	49, 200
	267, 200	328, 700

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[35] Écho des Mines et de la Métallurgie, Paris, 58th year, July 1, 1930, p. 531; Iron and Coal Trades Rev., vol. 70, No. 3237, Mar. 14, 1930, p. 457.

Of the imports in 1929, Luxemburg took about 125,000 metric tons. Belgium produces practically no manganese ore and is forced to rely upon foreign sources for its supply.

CZECHOSLOVAKIA

About 97,000 metric tons of ferruginous manganese[36] ore was mined in Czechoslovakia during 1929, the average manganese content of which is reported to be 17.37 per cent.

FRANCE

Imports of manganese ore into France continued to increase in 1929, reaching a postwar record of 800,232 metric tons, as compared with 738,226 tons in 1928, an increase of 8 per cent. In 1928 and 1929 imports came from the following countries:

Manganese ore imported into France, 1928 and 1929, by countries, in metric tons [1]

Country	1928	1929
British India	267, 095	276, 884
Russia	110, 410	184, 038
Gold Coast	78, 442	102, 729
Brazil	43, 171	71, 664
Asia (other)	42, 463	36, 876
Spain	13, 240	19, 273
Other countries	183, 405	[2] 108, 768
	738, 226	800, 232

[1] American Metal Market, vol. 38, No. 79, Apr. 24, 1930, p. 1.
[2] Germany, 83,561 tons.

During recent years imports of manganese ore into France have appeared to be far greater than its needs. This situation has recently been summarized as follows:[37]

> Large imports of manganese into France have formed a feature of the international trade for several years, * * *. As the French steel output is relatively small, and its production of ferromanganese by no means commensurate with such large imports, there is considerable interest as to the use made of so much ore. Details of the actual consumption of manganese per ton of steel made in France are not available, but the ratio between the manganese content of net imports of manganese ore and ferromanganese to steel produced is considerably higher than in other countries. In 1929, for instance, net imports were equivalent to 85.3 pounds of metallic manganese per ton of steel produced. This figure compares with 14 pounds of manganese per ton of steel in the United States. At the present rate France is importing more manganese ore than the total imports plus production of metallurgical ore in the United States, despite the fact that steel production in France is approximately only one-sixth that of this country.

A French article[38] attempts to explain the large importation as follows:

> The large importation of manganese ore into France continues to interest Americans who do not understand that we have reached such a consumption of ore. We have again verified the figures of the customs bureau for 1929, which show 800,511 metric tons. In reality this figure ought to be reduced to 731,000 tons by the elimination of manganiferous iron ore (15,800), of the ore in transit for Luxemburg (24,500), and of the tonnage adjustment from one year to the other (29,200).

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[36] Bailey, J. W., Am. consul, Prague, Sept. 4, 1930.
[37] Lloyd, D. P., International Trade in Manganese Ore: First Quarter of 1930, Commerce Rept. No. 22, June 2, 1930, p. 565.
[38] Écho des Mines et de la Métallurgie, Paris, 58th year, July 10, 1930, pp. 359–360.

We therefore received 731,000 tons in 1929 for France and the Saar, which produced respectively 9,699,000 tons and 2,208,900 tons steel ingots, a total of 11,907,900 tons. This makes an average consumption of about 25 kilos of manganese metal per ton of steel, figuring 460 kilos of manganese per ton of ore, but the Americans who have produced 56,000,000 tons of crude steel in 1929 used less than 4 kilos per ton of steel produced.

French consumption of manganese ore in all industries during 1927 was estimated at roughly 500,000 tons.[39] Domestic production in 1929 was not more than 1,900 tons.

The production[40] of ferro-alloys in France during 1927 and 1928 was as follows:

Ferro-alloys produced in France, 1927 and 1928, by varieties, in metric tons

Variety of alloy	1927	1928
Special spiegel	150, 634	101, 892
Ferromanganese	36, 766	64, 165
Ferrosilicon	22, 696	33, 279
Silicomanganese		5, 518
Other alloys	10, 100	5, 713
	220, 196	210, 567

From these figures it is evident that the total ferro-alloy production does not account for the enormous imports. The large spiegeleisen output indicates that much of the manganese ore went indirectly into the manufacture of Bessemer steel. The crude-steel production in 1929 was 9,670,000 metric tons, compared with 9,478,000 tons in 1928.

French pig-iron production in 1929 was about 10,446,000 metric tons, but it is not known whether any of this was manganiferous pig iron.

GERMANY

Germany imported 390,282 metric tons of manganese ore in 1929, compared with 284,240 tons in 1928, an increase of 37 per cent. The imports of ferromanganese amounted to 3,172 metric tons in 1929, compared with 4,369 tons in 1928, a decrease of 27 per cent. Exports of ferromanganese increased from 18,005 metric tons in 1928 to 20,143 tons in 1929, a gain of 12 per cent. The source of the imported manganese ore in 1929 was about as follows:

	Metric tons		Metric tons
Russia	178, 756	Asia (other)	1, 981
British India	130, 546	Brazil	3, 675
Australia	23, 443	Miscellaneous	2, 900
Egypt	35, 606		
Dutch East Indies	7, 890		390, 282
Rumania	5, 485		

GREECE[41]

Production of manganese ore in 1928 amounted to 1,080 metric tons and consumption or shipments amounted to 1,336 tons; in 1927 production amounted to 8,283 tons. Stocks on December 31, 1927, were 5,858 tons. The ore mined in 1928 ranged from 25 to 45 per cent manganese.

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[39] Mines et Carrières, 8th year, No. 83, September, 1929, p. 131.

[40] American Metal Market, vol. 37, No. 65, Apr. 3, 1930, p. 9.

[41] Statistique de l'Industrie Minière de la Grèce, Ministère de l'Économie Nationale, Athens, 1929, pp.7-8.

The principal producers were the Société "Mines de Calamata," in the Leyka district, George N. Georgiou at Poplits, J. D. Kokinis at Andros, and S. Couloumpini at Calamata (Crimnismeni). The Société Minière "Bani Milos," at Milos, which produced in 1927, did not operate in 1928.

Ferruginous manganese ore containing 30 per cent iron and 12 to 14 per cent manganese has been mined in the past at Laurium by the Compagnie Française de Mines du Laurium and the Société des Usines du Laurium, but in 1928 only a few tons was mined and no shipments were reported.

HUNGARY [42]

Extensive new deposits of manganese ore have been discovered in Hungary, and the reserves are said to be sufficient to make that country independent of foreign sources for some time. The State iron works at Diosgyor proposes to erect an electric furnace plant for the manufacture of ferromanganese. Production of manganese ore in Hungary has been increasing rapidly since 1924, as shown by the following statement.

	Metric tons		Metric tons
1924	1, 217	1927	17, 272
1925	3, 100	1928	22, 167
1926	9, 909	1929	19, 044

ITALY

Italy relies chiefly on imports for its supply of manganese ore. In the first six months of 1929, Italy imported 46,500[43] metric tons of manganese and manganiferous ores, compared with 32,200 tons for the corresponding period in 1928. Assuming the same rate for the whole year,[44] the total imports in 1929 would amount to approximately 93,000 metric tons. Russian export statistics report that more than 66,000 metric tons was sent to Italy during the fiscal year ended September 30, 1929.

Italy produced about 9,900 metric tons of manganese ore in 1929, compared with about 10,300 tons in 1928. In addition, Italy has produced ferruginous manganese ore[45] annually, as follows:

	Metric tons		Metric tons
1922	3, 361	1926	18, 230
1923	19, 268	1927	17, 550
1924	18, 942	1928	15, 600
1925	17, 345	1929	6, 838

This industry has largely developed since the war, especially around Piombino. Increased activity has been evident in the iron-manganese mines of Grosseto Province. These mines are owned by the Società Ilva, which manufactures iron and steel.

NORWAY

Norway reports no domestic mining of manganese ore. It has, nevertheless, developed a large electrometallurgical industry for the manufacture of ferro-alloys,[46] such as ferrosilicon, ferromanganese, ferrochromium, etc. The ferro-alloy production in 1929 amounted to 124,536 metric tons, compared with 119,218 tons in 1928. During 1929 Norway exported 68,980 metric tons of ferromanganese,[47] compared with 77,130 tons in 1928; exports of ferrosilicon increased from 20,772 tons in 1928 to 40,896 tons in 1929.

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[42] Iron and Coal Trades Review, London, vol. 119, No. 3212, Sept. 20, 1929, p. 435.

[43] Mining Journal (London), vol. 167, No. 4918, Nov. 23, 1929, p. 635.

[44] Mining Journal (London), vol. 169, No. 4945, May 31, 1930, p. 444.

[45] Relazione sul Servizio Minerario, Corpo Reale delle Miniere, Rome. (Annual.)

[46] Canadian Mining Journal, vol. 50, No. 50, Dec. 13, 1929, p. 1191.

RUSSIA

During 1928–29 Russia is reported to have produced 1,200,000 metric tons of manganese ore, compared with 498,800 tons in 1927–28, an increase of about 140 per cent. This output was distributed[48] as follows:

	Nikopol	Chiaturi	Total
1927–28	220, 400	278, 400	498, 800
1928–29	450, 000	750, 000	1, 200, 000

The following statement shows the production of manganese ore in Russia since 1924–25:

	Metric tons
1924–25	676, 502
1925–26	1, 028, 607
1926–27	843, 850
1927–28	498, 800
1928–29	1, 200, 000

Exports[49] during the fiscal year 1928–29 amounted to 899,969 metric tons, compared with 498,881 tons in 1927–28. This ore went to the following countries:

Manganese ore exported from Russia, 1927–28 and 1928–29, by countries, in metric tons

Country	1927–28	1928–29
Belgium	65, 908	98, 251
France	64, 532	132, 812
Germany	44, 062	46, 170
United Kingdom	13, 174	18, 519
Holland	44, 953	115, 832
Italy	46, 344	65, 537
Poland	30, 820	38, 514
United States	189, 088	343, 387
Other countries	------------	40, 947
	498, 881	[1] 899, 969

[1] Exports for the calendar year 1929 were 1,037,072 tons, indicating heavy shipments during the last three months of the year.

Battery ore exports during 1928–29 amounted to 25,000 to 30,000 tons, making a total of about 925,000 to 930,000 tons of ore of all classes.

During the year at Chiaturi about 8,000 workmen operated 20 mines and 21 washeries, a considerable increase over the activity of the Harriman concession. This indicates a considerable advance toward the fulfillment of the schedule of the 5-year[50] plan which calls for a manganese ore output of 2,290,000 tons in 1932–33; washed ore is to be increased to 1,300,000 tons by the centralization and mechanization of the mines and washing plants. Improvement of transport facilities and construction of a ferromanganese plant are included in the plan.

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[47] Mining Journal (London), vol. 168, No. 4928, Feb. 1, 1930, p. 79.
[48] Mining Journal (London), vol. 167, No. 4917, Nov. 16, 1929, p. 915.
[49] Metal Bulletin, No. 1524, Sept. 9, 1930, p. 15.
[50] South African Mining and Engineering Journal, vol. 40, No. 1985, Oct. 12, 1929, p. 137.

A contract[51] has recently been let to the Siemens-Schuckert Co. (German) for the construction and equipment of the proposed ferromanganese plant. The cost of the works is estimated at 12,000,000 rubles, and the rated capacity will be 100,000 to 150,000 tons of alloy a year. This plant evidently was substituted as an alternative to the aluminum plant proposed[52] in connection with the Dnieper hydroelectric power station which has a rated capacity of 360,000,000 kilowatt-hours. Ferrochromium, ferrosilicon, and ferrotungsten will also be made. The total cost of all improvements at Chiaturi and the Dnieper station is estimated at 25,000,000 to 30,000,000 rubles. The manganese ore production and ferromanganese manufacture may be included in the new amalgamation of the metallurgical and ore industries under one head, as follows:[53]

> The Soviet authorities have approved the new scheme for the amalgamation of the metallurgical and ore industries which will be brought into one organization styled "Stal" with a capital of 1,000 million rubles. "Stal" will be responsible for the production and sale of metals and ores within the whole Soviet Union and will have the right to deal direct with foreign markets, its authority in the latter connection being apparently quite independent of any other Soviet body. It remains to be seen how this will affect the existing export organizations such as "Manganexport" and the manganese ore producing group "Mangantrest." It is assumed that they will lose their separate identity and become mere subsidiaries of "Stal." There is no information as to how Messrs. Rawack & Grünfeld's contract with the Soviet ore producers will be affected.

While many reports from Russia indicate favorable progress during 1928–29, there are others who take a more pessimistic attitude.[54]

At the same time attacks[55] appear to have been made by the Russian press on M. Modebatse, the head of the Chiaturi manganese ore industry, complaining that the individual output of the workers has lagged some 14 per cent behind the program during the first few months of the current fiscal year.

SPAIN

The production of manganese ore in Spain during 1929 was 17,872 metric tons, compared with 13,704 tons in 1928. In addition, considerable tonnages of ferruginous manganese and manganiferous iron ores are mined and shipped annually.

UNITED KINGDOM

The United Kingdom imported 289,353 long tons of manganese ore in 1929, compared with 205,965 tons in 1928 and 198,527 tons in 1927. In addition, 64,000 tons of manganiferous iron ore was brought in in 1929, compared with 46,778 tons in 1928.

Imports of ferro-alloys[56] amounted to 26,778 long tons in 1929, compared with 25,483 tons in 1928. The 1929 imports were from the following countries:

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[51] Mining Journal (London), vol. 167, No. 4916, Nov. 9, 1929, p. 905.
[52] Mining Journal (London), vol. 165, No. 4896, June 22, 1929, p. 523.
[53] Metal Bulletin (London), No. 1469, Feb. 14, 1930, p. 15.
[54] Iron Age, vol. 125, No. 19, May 8, 1930, p. 1436.
[55] Metal Bulletin (London), No. 1487, Apr. 25, 1930, p. 7.
[56] Metal Bulletin (London), No. 1461, Jan. 7, 1930.

	Long tons
Norway	15, 339
Sweden	11, 306
United States	133
	26, 778

Exports of ferro-alloys in 1929 amounted to 89,577 long tons, compared with 58,068 tons in 1928; the exports in 1929 were distributed as follows:

	Long tons
United States	32, 986
Belgium	18, 490
France	8, 849
Australia	4, 033
Germany	5, 048
Canada	3, 750
Others	16, 421
	89, 577

YUGOSLAVIA

The production of manganese ore in Yugoslavia from 1925 to 1929 was as follows:

	Metric tons
1925	2, 716
1926	1, 244
1927	1, 971
1928	2, 660
1929	3, 072

According to Austrian advices [57] the Smelting & Refining Co., which already possesses interests in the Bosnian mines, has leased a manganese property in the neighborhood of Užice and has opened negotiations for the acquisition of coal mines at Ptschini. It is presumed that the company intends to manufacture ferromanganese or spiegeleisen.

ASIA

CHINA

Exports of manganese ore from China [58] in 1929 amounted to about 42,000 long tons, compared with about 43,000 tons in 1928. The following statement shows the exports from 1925 to 1929:

	Long tons
1925	42, 577
1926	41, 790
1927	45, 619
1928	42, 648
1929	41, 797

The deposits of manganese ore in China are located in the Provinces of Hunan, Kiangsi, Kwangsi, and Kwangtung (South China). Practically the whole of the South China [59] output of manganese ore has been absorbed by Japan, and although European and American interests have been making bids they are unable to compete with the Japanese buyer who is able to offer better prices for the ore on account of the low exchange rate, which is still on the downward trend. It is estimated that 10,000 tons of manganese ore was purchased by Japan during 1929. Shipments of ore from the mines at Kwangsi to Hong Kong have been difficult because of banditry and civil commotions in the area through which the ore must pass. Toward the end of the year business apparently ceased, due to trouble in Kwan, Kwangsi, and Kwangtung. Later, hostilities stopped and it was believed that shipments would be resumed early in 1930.

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[57] Metal Bulletin (London), No. 1466, Feb. 4, 1930, p. 15.

[58] Foreign Trade Notes, No. 283, Mar. 13, 1930, p. 6.

[59] See footnote 58.

INDIA

In 1929 the production of manganese ore in India was 994,279 long tons, valued at £1,571,030, compared with 978,449 tons, valued at £2,321,201, in 1928, an increase of 2 per cent in quantity and a decrease of 32 per cent in value. This brings the total output from 1892 to 1929, inclusive, to about 18,808,000 long tons. The following table shows the quantity and value of manganese ore mined in India, 1927 to 1929, by Provinces and districts.

Manganese ore produced in British India, 1927–1929

Province and district	1927		1928		1929	
	Long tons	Value f.o.b. at Indian ports	Long tons	Value f.o.b. at Indian ports	Long tons	Value f.o.b. at Indian ports
Bihar and Orissa:						
Gangpur State	7, 960	£20, 928	6, 379	£16, 134	----------	----------
Keonjhar State	51, 115	103, 721	72, 411	140, 598	53, 433	£62, 338
Singhbhum	9, 970	26, 213	23, 199	58, 674	22, 698	38, 965
Bombay:						
Chhota Udaipur	11, 729	30, 398	7, 267	18, 122	9, 415	15, 888
Belgaum	4, 515	11, 871	1, 603	4, 054	8, 666	14, 877
North Kanara	4, 005	10, 530	3, 601	9, 107	6, 245	10, 721
Panch Mahals	78, 802	207, 184	63, 040	159, 439	56, 326	96, 693
Central India: Jhabua State	10, 510	22, 728	3, 835	7, 926	----------	----------
Central Provinces:						
Balaghat	313, 556	871, 424	248, 497	663, 694	263, 105	482, 359
Bhandara	130, 211	361, 878	89, 059	237, 862	156, 525	286, 962
Chhindwara	47, 264	131, 355	37, 069	99, 005	29, 814	54, 659
Jubbulpore	181	503	----------	----------	----------	----------
Nagpur	252, 637	702, 120	216, 509	578, 259	172, 559	316, 358
Madras:						
Bellary	6, 004	9, 782	5, 257	8, 236	10, 535	9, 131
Sandur State	138, 196	225, 144	139, 801	219, 021	140, 604	121, 857
Vizagapatam	31, 992	56, 386	29, 094	49, 217	24, 533	23, 715
Mysore State:						
Chitaldrug	4, 021	6, 819	1, 907	3, 107	667	611
Shimoga	23, 658	40, 120	27, 994	45, 607	38, 436	35, 233
Tumkur	3, 027	5, 133	1, 927	3, 139	718	663
	1, 129, 353	2, 844, 237	978, 449	2, 321, 201	994, 279	1, 571, 030

Exports of manganese ore from India increased from 834,144 long tons in 1928 to 964,489 tons in 1929. The following table shows the exports of Indian manganese ore, 1927 to 1929, by ports of shipment.

British Indian manganese ore exported from India, 1927–1929, by ports of shipment, in long tons [1]

Port	1927	1928	1929
Bombay	249, 360	270, 961	325, 268
Calcutta	418, 173	378, 604	440, 302
Madras	13, 910	9, 002	13, 980
Mormugão (Portuguese India)	162, 378	175, 577	184, 939
	843, 821	834, 144	964, 489

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[1] Records of the Geological Survey of India, vols. 61 and 62, pt. 3, 1928 and 1929, pp. 229 and 316.

The exports of manganese ore from British Indian ports were largely sent to the United Kingdom, France, Belgium, the United States, Netherlands, and Germany. In 1929 exports to the United Kingdom, France, and Netherlands increased, whereas those to the United States, Belgium, and Germany dropped off. The following table shows the exports of manganese ore from British Indian ports, 1927 to 1929, according to the countries to which the ore was shipped. The figures do not include any ore exported from Portuguese India.

Manganese ore exported from British Indian ports, 1927–1929, by countries, in long tons

Country	1927	1928	1929
United Kingdom	211, 401	159, 227	264, 537
Germany	12, 805	20, 945	12, 630
Netherlands	12, 500	7, 501	36, 350
Belgium	174, 485	183, 897	181, 174
France	151, 100	195, 576	219, 055
Italy	5, 150	9, 475	4, 246
Japan	15, 502	--------	--------
United States	97, 500	76, 000	51, 250
Other countries	1, 000	5, 946	10, 308
	681, 443	658, 567	779, 550

The most important [60] company operating in India, the Central Provinces Manganese Ore Co. (Ltd.), operates about 12 properties. This company was employing approximately 12,000 workmen during the middle of 1929. Half of the labor force is men and the remainder women, the minimum age being about 16 years. The larger deposits operated by the company are located 40 to 50 miles northeast from Nagpur. Nagpur is roughly 800 miles east of Bombay, 670 miles south of west from Calcutta, and 400 miles northwest of Madras. It is said, however, that although Madras is only half as far as Bombay the freight rate is as high, and as Bombay is on the side nearer to Europe it makes the best place to ship from on account of the time required for steamers to reach the market. The company has an annual production capacity of about 750,000 long tons of ore averaging 50 per cent manganese, 7 per cent iron, 0.10 to 0.11 per cent phosphorus, and 7 to 9 per cent silica. It is believed that the total yearly output might be increased to as much as 1,000,000 tons if need be. The cost of production ranged from $1.82 to $2.18 per long ton, and freight to Bombay and Calcutta was about $4.70 to $4.75.

During 1929 the average price of Indian manganese ore, c. i. f. United Kingdom ports, was about 14d. per unit, compared with 17d. in 1928, 18.1d. in 1927, 18.4d. in 1926, 21.5d. in 1925, and 22.9d. in 1924. Fermor states that this continued fall in the price of manganese ore from 1924 to 1929 is to be correlated with the fact that from 1924 to 1927 the rate of increase of world production of manganese ore was much greater than the rate of increase of the world's production of pig iron and steel and with the building up of world stocks.

The situation in India with respect to present and potential competition with Russia is set forth in an interesting summary by Pascoe:[61]

> It might seem at first as if the termination of the Harriman interests in Russia would benefit the Indian producer. * * * A German firm has been appointed agents for the Soviet, and if their agreement be on a commission basis, it will be

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[60] Data obtained from F. L. Hess, U. S. Bureau of Mines (from notes on his trip to India in 1929).

[61] Pascoe, Sir Edwin, The Mineral Production of India during 1928: Records of the Geol. Survey of India, vol. 62, Pt. 3, Calcutta, 1929, pp. 312–316.

to their advantage to keep prices at a reasonable level. At the same time it is in their power to undersell all outsiders, and it will be to their advantage to sell as much ore as possible even perhaps at reduced rates. Their position is to some extent controlled by the fact that the manganese ore, as mined in Russia—especially that from Nikopol—requires considerable washing treatment to produce a material suitable for metallurgical uses. Cleaning plants have been erected in Russia, but the Soviet have found that from their point of view it is more economical to revert to hand washing the ore as was done before the war. This reversion, however, will not necessarily keep down production, as the Russian export of high-grade manganese ore before the war exceeded 1,000,000 tons, and there is no reason to suppose that this figure can not again be achieved under the same methods of production. Another consolation for the Indian producer is the fact that the Russian product is small and soft and has to be mixed with a certain proportion of hard ore before it can be employed successfully.

There is little doubt that the Russians at present hold the key to the manganese situation. Unless some mutual arrangement is come to, therefore, it would be possible for them by selling at a lower price for cash to keep prices below the economic limit. Any such cartel would probably have to include producers of the lower grades of ore, as it is conceivable that the metallurgists could and might make use of a lower grade of ore if the better grades were available only at too high a price. According to "Die Metallbörse" the Russian Press state that the cost of preparing first-grade manganese ore for the market has increased lately by 17 per cent, owing to the lack of adequate technical supervision and of sufficient drill steel for use in breaking down the rock; the increased costs, however, appear to be spread over the washing operations as well as the actual ore getting.

The Central Provinces Manganese Ore Co. (Ltd.) [62] has succeeded in securing a lower freight rate on its lower-grade ores which previously could not be worked at a profit because of the severe competition from Russian producers. Also, Indian producers had entered into long-term contracts with British ferromanganese concerns at a price reported to be higher than present quotations; as a result they have been able to operate at a profit. In addition, port rates have likewise been reduced at both Calcutta and Bombay. The new sidings on the Tumsar-Tirody Extension were linked up except Sitapatore, which was expected to be finished in a short time. The outlook is said to be favorable, even though it was indicated [63] that some mines in India were closed down; this report states that the harbor at Vizagapatam is not expected to be complete before 1932.

JAPAN

The production of manganese ore in Japan amounted to 18,155 long tons in 1929, compared with 17,413 tons in 1928. This production, however, is inadequate for domestic needs. Imports are brought largely from China, Australia, and India.

The deposits [64] of Japan are located in the prefectures of Hokkaido, Kyoto, Aomori, Gifu, Oita, Tochigi, Nagano, and Shidzuoka. The principal mines are the Mirikain in Hokkaido, the Takasai in Aomori, and the Kitayama in Kyoto. The chemical ores average 82 per cent MnO_2, and the metallurgical ores run 43 to 56 per cent manganese, 7 to 10 per cent silica, and 0.5 per cent phosphorus.

The best brownstone containing 87 per cent MnO_2 sells for twice the price of the 70 per cent ore.

As a part of the plan [65] of the Government Steel Works at Yawata to supply all Japanese steel requirements, the production of ferromanganese is to be increased. At present the Government Steel Works produce only 50 to 60 metric tons of ferromanganese a month, although the imports are large.

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[62] Mining Journal (London), vol. 169, No. 4938, Apr. 12, 1930, p. 364.
[63] Engineering and Mining Journal, vol. 129, No. 2, Jan. 23, 1930, p. 99.
[64] Zereteli, Datico, Manganese Ores: London, 1925, pp. 71-72.
[65] Iron Age, vol. 126, No. 7, Aug. 14, 1930, p. 470.

NETHERLAND EAST INDIES

Production of manganese ore in Netherland East Indies in 1929 is reported as 20,997 metric tons, with a manganese content of from 48 to 56 per cent, as compared with 24,452 tons in 1928.

TURKEY

During 1928 and 1929 a German company, Südanatolische Bergbau, A. G., was developing manganese deposits in the vicinity of Makri. In the latter part of February, 1930, it was announced [66] that the International Manganese Corporation had been incorporated in the United States as a holding company to own a percentage of shares of the German corporation. The manganese concessions are located at Geodjek, in southern Anatolia, about 100 miles east of the island of Rhodes. The deposits are only 4 miles from the coast and are estimated to contain some 10,000,000 tons of ore running about 45 per cent manganese. The mine was reported to be in operation and the entire output for the first half of 1930 was sold to French companies. Shipments to America were expected in the latter half of the year.

AFRICA

ALGERIA

Algeria exported 436 metric tons of manganese ore in 1929, compared with 1,476 tons in 1928. France took 800 tons of the 1928 shipments.[67]

MOROCCO

The manganese deposits of Bou Arfa attracted considerable interest during the year and show signs of developing into an important source of high-grade ore. The situation [68] is summarized thus:

> As a result of greatly improved equipment of the mines in Morocco, shipments of manganese ore, amounting to from 80,000 to 90,000 tons, may be expected for the year 1930. Progressive increase of shipments in the following years is contemplated. The ore reserves of the main bearings of Bou Arfa are at present estimated at about 2,000,000 metric tons, and it is further estimated that the reserves of the entire territory amount to 20,000,000 metric tons. The present definitely surveyed reserves alone assure a regular annual output of 200,000 to 300,000 metric tons for some time to come.
>
> The present cost of production is estimated at about 30 francs per ton f. o. b car at station of shipment.
>
> The annual French consumption of manganese reaches 700,000 tons, which must be imported from abroad, but with the opening of the works at Bou Arfa and the possible discovery of other manganese deposits in eastern Morocco it is possible that France may become independent of this importation.
>
> An agreement was concluded between the Société des Mines de Bou Arfa and the French metallurgical industry, whereby the Bou Arfa Co. reserves for the French metallurgical industry 10 per cent of its capital and a part of its production at the world market price.

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[66] Iron Age, vol. 125, No. 8, Feb. 20. 1930, p. 617.

[67] Foreign Trade Notes, No. 247, May 25, 1929.

[68] Development of Manganese Production in Morocco: Am. Metal Market, Dec. 10, 1929, p. 10.

The Bou Arfa Co. obtained very favorable reduced tariffs of transportation in exchange for its participation in the construction and the equipment of this railway line.

The company also owns a vast mining area where iron, zinc, copper, and lead have been noted and where extensive prospecting work will be undertaken in the near future.

An official report[69] states that the completion of the railway from Bou Arfa to Oudja and from there to Nemours will make possible the exporting of 100,000 tons of manganese ore per annum. It is expected that the new line will be completed by 1931 and that shipments from stocks of ore now being mined will be made.

Other deposits[70] have been found in Morocco in the Atlas Mountains south of Marrakesh, in the region of Telouat at Imeni, and a tentative organization has been formed for the purpose of prospecting the fields. It is reported that the ore in these deposits contains 50 to 55 per cent manganese, but that it is of a friable nature and contains in places 5 per cent of lead. Another deposit is reported in the Goundafa district, also south of Marrakesh, near Aoulong, but the ore is said to be of inferior quality.

A new company,[71] Société Anonyme Chérifienne d'Études Minières, with a capital of 3,000,000 francs, has been promoted to prospect for manganese in southern Morocco. The promoters include the Société de Peñarroya, the Aciéries la Marine et Homécourt, and the Société du Manganèse.

SIERRA LEONE[72]

Several occurrences of manganese oxides have been found over a length of 45 miles, in the Sembehum and Gbangbama districts, Southern Province. The manganiferous material appears to have been formed by the weathering of granulites and gneisses rich in manganese garnet and containing some graphite. Samples from a deposit near Bradford showed 16.7 per cent manganese and 5.6 per cent graphite, and a sample of material from near Gbangbama ran 21.5 per cent manganese and 37.2 per cent silica. The ore is uneconomic at present.

TUNISIA

Tunisia produced 200 metric tons of manganese ore in 1929, compared with 2,200 tons in 1928 and 2,056 tons in 1927. Exports[73] in 1929 amounted to 1,993 metric tons, compared with 1,760 tons in 1928 and 1,178 tons in 1927.

A large company[74] is being launched to exploit manganese deposits at Aculouz in the Souss, at the head of the Souss Valley. It is reported that this company will push work forward rapidly and perhaps will build a narrow-gage railroad to the port of Agadir.

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[69] Iron and Coal Trades Review (London), vol. 120, No. 3232, Feb. 7, 1930, p. 243; Min. Jour. (London), vol. 167, No. 4912, Oct. 12, 1929, p. 834.

[70] Lloyd, D. P., Commerce Rept. No. 22, June 2, 1930, pp. 565-566.

[71] Mining Journal (London), vol. 167, No. 4919, Nov. 30, 1929, p. 959.

[72] Mining Magazine (London), vol. 42, No. 2, February, 1930, p. 81.

[73] Mining Journal (London), vol. 167, No. 4932, Mar. 1, 1930, p. 168.

[74] Foreign Trade Notes, No. 298, June 14, 1930, p. 5.

UNION OF SOUTH AFRICA

The first shipment of manganese ore from the Postmasburg Field[75] was made in November, 1929, and amounted to 550 short tons consisting of two types of ore. The first 250 tons was low-grade material averaging 44.66 per cent manganese, 14.18 per cent iron, 5.09 per cent silica, 0.075 per cent phosphorus, 0.089 per cent sulphur, 4.11 per cent alumina, and 0.13 per cent moisture. The second type was classed as high-grade ore and averaged 52.11 per cent manganese, 7.97 per cent iron, 4.83 per cent silica, 0.069 per cent phosphorus, 0.0915 per cent sulphur, 3.62 per cent alumina, and 0.15 per cent moisture. The important feature of the analyses is the very low moisture content, a matter of much importance in transportation costs. It is doubtful whether other shipments will be made before completion of the railway connecting Postmasburg with Durban, which was expected in 1930.

The South African Geological Survey has recently published a bulletin[76] on the Postmasburg area, which should be of interest to anyone studying the manganese possibilities of South Africa. According to this report, the Postmasburg manganese deposits may be divided into two belts—the Western or Gamagara belt and the Eastern or Klipfontein belt. The report summarizes the outstanding differences between the two belts as follows:

1. The manganese deposit of the Western Belt tends to form continuous outcrops extending for many hundreds, even thousands of yards, whereas in the Eastern Belt, detached ore bodies occur at irregular intervals.
2. The above difference is borne out by the fact that while in the Western Belt the form of the ore deposit at the surface is, in general, like that of a sheet, the Eastern Belt is largely characterized by vertical, highly irregular ore bodies with relatively small lateral extent.
3. In the Western Belt the available tonnage is clearly very much larger than in the Eastern Belt.
4. In the Western Belt manganese ore is associated with a series of rocks different from that in the Eastern Belt; i. e., in the two belts the ore is found in rocks of widely different ages.
5. Consequently the manganese deposits of the two belts are not circumdenuded outliers of a former ore sheet of regional extent.

The ore generally occurs in two types, massive (noncrystalline) and crystalline. The noncrystalline variety is usually psilomelane, whereas the crystalline variety is a mixture of psilomelane in braunite or an ore similar to a common variety of Indian ore. The massive form (noncrystalline) is a black, dark gray, or steel gray mineral showing no structure, when pure, other than jointing and an occasional irregular banding. This ore is hard and has a specific gravity of 4.66. Stalactitic, mammillary, or botryoidal forms are very rare, and the banding sometimes seen is due largely to segregation banding made up of layers of the three colors of the mineral. In the crystalline type the minerals vary in size from specks to practically pure crystalline aggregates. The crystalline mineral is harder than the noncrystalline type and has a specific gravity of about 4.7. The following table shows analyses of the crystalline and noncrystalline varieties.

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[75] South African Mining and Engineering Journal, vol. 40, pt. 2, Jan. 11, 1930, p. 518.

[76] Nel, Louis T., The Geology of the Postmasburg Manganese Deposits and the Surrounding Country: South African Dept. of Mines and Industries, Geol. Survey, Pretoria, 1929, pp. 60–96.

Analyses of crystalline and noncrystalline types of manganese ore

	I	II	III	IV
Metallic manganese	50.08	56.68	61.64	54.69
Metallic iron	1.68	.46	.35	6.49
Phosphorus	.04	.07	.04	.20
Sulphur	.05	.15	.04	----------
Water of constitution	2.10	1.50	.80	3.00
Moisture	.25	.70	.35	
Barium oxide	16.19	3.88	.35	----------
Calcium oxide	.30	.70	1.00	.42
Sodium	.20	.25	.30	----------
Potassium oxide	.40	1.10	.60	----------
Silica	.30	5.00	6.60	1.78
Miscellaneous	.66	.78	.21	3.04

I = Psilomelane, nodular variety from a trench on Klipfontein.
II = Massive type of psilomelane, from a trench on Beeshoek.
III = Coarsely crystalline type from the Klipfontein.
IV = Crystalline type of ore from Gloucester Farm.

The various grades of marketable ore are classified as follows:

(*a*) 21.85 metallic manganese and 39.06 metallic iron.
(*b*) 22.87 metallic manganese and 34.59 metallic iron.
(*c*) 32.02 metallic manganese and 27.07 metallic iron.
(*d*) 39.75 metallic manganese and 15.00 metallic iron.
(*e*) 52.16 metallic manganese and 4.27 metallic iron.

During the year the Manganese Fields (Ltd.) with a capital of 100,000 pounds sterling was formed for the purpose of taking over all the assets and liabilities of the Postmas Manganese Fields (Ltd.) and the Gamagara Manganese Corporation (Postmasburg) (Ltd.). The company owns options and leases on large areas, including Lilyveld and Klipfontein No. 24 farms. Lilyveld lies on the eastern slope of the Gamagara Range near its northern extremity, and about 40 miles by road from Postmasburg. Klipfontein lies about 12 miles north of Postmasburg. At Lilyveld the estimated possible tonnage, based on the measurement of an area 1,000 yards long by 800 yards wide, is 9,000,000 tons of ore averaging about 51.07 per cent manganese. However, it is probable that actual mining will lower this average somewhat. Klipfontein reserves have not been estimated, but considerable development work which discloses substantial quantities of ore of good grade has been completed.

The Manganese Corporation (Ltd.)[77] was incorporated in April, 1929, to acquire through the British Swiss International Corporation (Ltd.) the properties of the Union Manganese Mines & Minerals (S.A.) (Ltd.). The company's new crushing and sorting plant, capable of handling 2,000 tons daily, was expected to be completed by March or April, 1930. The ore will be railed to Durban,[78] where special equipment for loading on steamers is being installed. It has been reported that the company has placed several orders for 1930 delivery. Concerning the marketing of Postmasburg manganese ore, the Mining and Industrial Magazine[79] comments as follows:

> We learn too that Messrs. W. Muller & Co., of Rotterdam, the sole agents of the South African Manganese Corporation, have already sold in advance several large quantities of manganese in Europe. France has bought some thousands of tons, and the German steel industry has contracted for about 20,000 tons. In addition to this, negotiations with certain German firms are proceeding, and seem likely to result in contracts being placed for 40,000 tons per annum. The Manganese Corporation is giving guarantees as to grade and purity of the ore it will

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[77] South African Mining and Engineering Journal, vol. 40, pt. 2, No. 1992, Nov. 30, 1929, p. 353.
[78] Mining Journal (London), South Africa in 1929: Vol. 168, No. 4927, Jan. 25, 1930, p. 27.
[79] Mining and Industrial Magazine of South Africa, vol. 9, No. 7, Nov. 27, 1929, p. 264.

ship to Europe. The appearance of South African producers on the European markets has already caused a further decline in prices. Russian Nikopol ores have been at 10½d. per unit and a further decline is probable. The Indian mines are already out of the market and the closing of two of these mines is reported.

The agents of the South African Co. say that they will be able to reduce the price still further, if it should become necessary to do so. The Russian Government's trade paper, the Ekonomitschenskaja Shin, states that the Russian Government's manganese ore trust (the Georgian Manganese Co.) has made an offer to the South African, Indian, and Brazilian manganese companies to enter into negotiations with the object of terminating the present price war. It is suggested that a world manganese ore trust should be established to regulate the sale of ore at fixed prices.

The Iron and Coal Trades Review[80] states that, from latest advices, capital is being raised at Cape Town to reopen and work the manganese deposit at Hout Bay, which was exploited unsuccessfully many years ago. The mine is in the hills above the bay, and has obviously very distinct advantages over its Postmasburg competitors in the matter of transportation facilities. A well-known German engineer has advised the reopening of the property.

WEST AFRICA (GOLD COAST)

Exports[81] of manganese concentrates from Gold Coast in 1929 amounted to the record total of 457,932 long tons (wet), equivalent to 408,224 long tons (dry). Exports amounted to 324,499 dry tons in 1928 and 369,205 dry tons in 1927. A daily record of 2,000 tons of ore was made in 1929.

The African Manganese Co.[82] hopes to begin exporting manganese ore and concentrates from its new wharf at Takoradi Harbor early in 1930. It is calculated that the facilities at this port will permit the handling of 1,000 tons an hour. A large depot is being erected at Takoradi and will shortly be completed. The object of this depot is to enable large quantities of manganese ore to be stored on the deep-water wharf so as to be available for instant shipment if necessary. Moreover, the most up-to-date loading appliances have been installed, thus enabling a vessel to be filled in a minimum of time.

MANGANESE ORE IMPORTED INTO MAIN CONSUMING NATIONS

The following table shows the imports of manganese ore into the leading steel-manufacturing nations and the indicated source of the ore.

Manganese ore imported into the principal consuming countries, 1925–1929, by countries from which imported, in long tons [a]

Importing country	Country from which imported	1925	1926	1927	1928	1929	Source of information
Belgium-Luxemburg Economic Union.	Brazil	6,103	2,076	--------	37,752	18,263	Official trade returns.[b]
	British India	134,312	154,031	94,857	122,977	149,868	
	Egypt	3,037	26,498	980	--------	--------	
	Portuguese India	10,197	4,486	--------	--------	19,270	
	Russia	41,221	65,819	75,183	62,349	87,610	
	Other countries	2,080	11,484	94,090	39,819	48,466	
		196,950	264,394	265,110	262,897	323,477	

[a] Data compiled by Minerals Division, Bureau of Foreign and Domestic Commerce.
[b] Figures for 1928 from Metal Bulletin.

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[80] Iron and Coal Trades Review (London), vol. 120, No. 3227, Jan. 3, 1930, p. 30.
[81] Mining Journal (London), vol. 168, No. 4935, Mar. 22, 1930, p. 220.
[82] According to an address delivered by the Governor General of the Gold Coast at Accra on Feb. 17, 1930

Manganese ore imported into the principal consuming countries, 1925–1929, by countries from which imported, in long tons—Continued

Importing country	Country from which imported	1925	1926	1927	1928	1929	Source of information
France	Brazil	14, 142	12, 482	22, 174	42, 489	70, 532	Commerce Extérieur de la France.[c]
	British India	193, 199	239, 541	257, 077	262, 877	272, 512	
	British West Africa	46, 780	37, 074	31, 984	77, 203	101, 107	
	Russia	48, 539	90, 534	77, 508	108, 667	181, 132	
	Spain	43, 377	47, 880	40, 546	13, 031	18, 969	
	Other countries of Asia	42, 967	40, 531	34, 979	41, 793	36, 294	
	Other countries	73, 143	132, 961	184, 904	180, 511	107, 050	
		462, 147	601, 003	649, 172	726, 571	787, 596	
Germany	Brazil	10, 463	5, 977	2, 529	27, 372	3, 617	Official German trade statistics.
	British India	68, 063	46, 536	75, 431	124, 594	128, 485	
	British West Africa	15, 330	6, 511	(d)	(d)	(d)	
	Dutch East Indies	1, 726	4, 206	6, 133	12, 567	7, 765	
	Egypt	12, 768	17, 054	46, 092	29, 489	35, 044	
	Russia in Europe	6, 713	58, 420	(d)	(d)	(d)	
	Russia in Asia	55, 284	33, 058	207, 312	71, 060	175, 933	
	Other countries	25, 879	24, 208	29, 567	14, 669	30, 421	
		196, 226	195, 970	367, 064	279, 751	[e]381, 265	
Great Britain	British countries:						Annual Statement of the Trade of the United Kingdom with Foreign Countries and British Possessions.
	British India	170, 096	81, 710	176, 757	175, 378	(f)	
	Gold Coast	14, 148	20, 844	505	1, 319	(f)	
	Other British countries	593	56	130	1, 500	(f)	
		184, 837	102, 610	177, 392	178, 197	(f)	
	Foreign countries:						
	Brazil	11, 908	--------	1	8, 010	(f)	
	Japan and possessions	27	--------	--------	--------	(f)	
	Java	--------	--------	1, 973	1, 998	(f)	
	Netherlands	442	96	197	583	(f)	
	Portuguese possessions in India.	20, 317	6, 387	--------	13, 005	(f)	
	Russia	55. 985	32, 101	13, 061	1, 750	(f)	
	Spain	2, 051	--------	3, 291	--------	(f)	
	Other foreign countries	3, 080	3, 114	2, 612	2, 422	(f)	
		93, 810	41, 698	21, 135	27, 768	(f)	
		278, 647	144, 308	198, 527	205, 965	289, 353	
Netherlands	Belgium	139	58	--------	--------	--------	Maandstatistiek van den in-uit-en Doorvoer.
	Dutch East Indies	1, 714	1, 361	1, 212	1, 895	1, 231	
	Egypt	1, 000	--------	--------	3, 200	6, 339	
	France	246	438	453	257	639	
	Germany	381	179	225	316	289	
	Italy (Fiume)	24	386	--------	--------	--------	
	Norway	5	140	--------	--------	--------	
	Russia in Europe	--------	--------	3, 961	300	4, 618	
	Other countries	137	2	803	54	325	
		3, 646	2, 564	6, 654	6, 022	13, 441	
United States	Africa (British):						Foreign Commerce and Navigation of the United States.
	South	--------	12, 946	--------	5	--------	
	West	66, 146	100, 614	87, 230	24, 186	33, 593	
	Brazil	228, 438	272, 287	174, 026	142, 300	216, 535	
	British India	48, 967	63, 742	93, 017	83, 600	72, 940	
	Canada	2, 498	417	430	3, 929	4, 804	
	Chile	7, 154	8, 213	3, 206	9, 340	2, 000	
	China	510	--------	--------	--------	--------	
	Cuba	12, 745	14, 112	8, 976	3, 180	2, 667	
	Egypt	--------	--------	--------	--------	101	
	Germany	96	150	65	133	1, 137	
	Hong Kong	1, 296	--------	--------	--------	--------	
	Italy	--------	6, 083	--------	--------	71	
	Java and Madura	--------	594	1, 527	1, 026	1, 000	
	Netherlands	10	25	--------	--------	--------	
	Norway	--------	3, 542	--------	--------	--------	
	Russia in Europe	238, 618	254, 885	253. 544	159, 842	329, 336	
	United Kingdom	3, 275	206	46	167	85	
		[g]609, 753	737, 816	622, 067	427, 708	664, 269	

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[c] American Metal Market, vol. 38, No. 79, April 24, 1930, p. 1.

[d] Included under "Other countries."

[e] Germany also imported 23,073 tons from Australia, 5,398 tons from Rumania, and 1,950 tons from "other" Asia.

[f] Information not available.

[g] This figure differs from estimate shown on p. 278 and is due to difference between figures furnished by producers of Cuba and those furnished by the Bureau of Foreign and Domestic Commerce.

TIN[1]

By CHARLES WHITE MERRILL[2]

GENERAL SUMMARY

Tin is the only metal of which the United States annually consumes more than $20,000,000 worth and yet remains a negligible producer. In fact, the value of the tin imported for consumption in 1929 was far above this figure, exceeding $90,000,000. Moreover, the tin thus imported accounted for almost half of the world production. This was augmented by a domestic output that amounted to less than one-fiftieth of 1 per cent of the world's total output.

Tin stands tenth in value among the leading commodities imported for consumption in the United States and accounts for 2.1 per cent of the total domestic imports. Copper is the only mineral product the import value of which exceeds that of tin; the value of copper exports, however, exceeds that of copper imports, whereas tin exports are negligible. The importance of a steady flow of tin into the United States is apparent when it is remembered that tin is indispensable to two of the largest domestic industries—the automobile and canning industries.

The domestic production of tin in 1929 amounted to 35.1 long tons, valued at $35,600—34.5 tons from Alaska, 0.4 ton from California, and 0.2 ton from South Dakota. However, the recovery of secondary tin—that is, the production of tin from sources other than ore—in the United States is of great importance. More than one-fourth of the domestic supply of tin is now annually obtained in this manner.

Summary of statistics for tin in the United States, 1927–1929

	1927	1928	1929
Production......long tons..	24	42	35
Monthly price of Straits tin in New York:			
Highest......cents per pound..	69.31	55.64	49.37
Lowest......do....	57.63	47.10	39.79
Average......do....	64.37	50.46	45.19
Imports for consumption......long tons..	71,142	77,970	87,127
Exports (domestic and foreign)......do....	2,239	1,617	1,930
Reclaimed tin......do....	32,946	31,964	30,625

The world mine production of tin in 1929 amounted to 185,000 long tons, an increase of 4 per cent over the 178,396 tons produced in 1928. The output of the three leading producing countries amounted to 143,971 tons in 1929, or 78 per cent of the world total; the Federated Malay States produced 67,042 tons, or 36 per cent of the world total; Bolivia, 46,343 tons, or 25 per cent; and the Netherland East Indies, 30,586 tons, or 17 per cent. The smelter production of tin was even more localized than the mine output, as the three leading tin-smelting countries produced more than nine-tenths of the world total; the Straits Settlements contributed one-half, the United Kingdom one-third, and the Netherland East Indies, one-seventh.

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[1] Work on manuscript completed November, 1930.

[2] Figures on imports into and exports from the United States compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

The principal supply to consumers in the United States enters the domestic market as imported refined pig tin, mainly from the Straits Settlements, United Kingdom, the Netherlands, and China. The imports of tin in 1929 were 87,127 long tons, an increase of 12 per cent over the 77,970 tons imported in 1928. The total value of the imports in 1929 was $91,838,781, an increase of 6 per cent over the value of imports in 1928. The relatively small increase in value compared with the larger increase in quantity was the result of the declining price of tin. During 1928 the price for Straits tin in New York averaged 50.46 cents a pound but in 1929 the price fell to an average of 45.19 cents a pound, a decline of 10 per cent. Thus the prophecy [3] of A. B. Parsons quoted in the 1928 chapter of this series was almost fulfilled.

In spite of the decline in price, the world's "visible" stocks (in Government warehouses and in transit) continued to grow throughout the year, increasing from 24,563 long tons on December 31, 1928, to 28,140 tons on December 31, 1929, the highest in the history of the industry. Data concerning the change in stocks held by consumers, merchants, brokers, and others are not available. A minimum of 12,000 tons in "visible" stocks is considered necessary for undisturbed flow of tin from producers to consumers. In 1927 the monthly average of "visible" stocks was reduced to a quantity less than 3,000 tons above this minimum, thus placing the producers in a very favorable position. In 1929, however, this surplus was increased to more than 16,000 tons, thus giving the consumers a source of supply that allowed them to dominate the market.

The bulk of the tin consumption in the United States is dependent upon relatively few industries. The activity in these industries may be used as a rough index of the amount of tin being consumed. The principal tin-consuming industries are food packing, automobile manufacture, and building. The packing of food is relatively stable from year to year and may be counted upon to absorb a fairly constant quantity of tin plate and solder. The automobile industry is subject to wide variation both in the number of units produced and the proportion of high-tin-content to low-tin-content cars. The year 1929 was outstanding for its high automobile output, but a large proportion of the increase was due to expanded production of the low-tin-content cars. The building trades are large users of terneplate, tin plate, and solder, and a variety of tin-bearing articles is used in the equipment of new buildings. The building trades are subject to wide fluctuations in their tin requirements, but 1929 was a year of at least normal activity.

The business depression that began in the latter part of 1929 will undoubtedly greatly decrease the amount of tin used in the United States during 1930 because of lessened activity in the automobile and building industries. However, the producers of tin can look toward the future with a degree of optimism as much business, particularly in the building trades, is not lost but only postponed.

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[3] Parsons, A. B., Is 45-Cent Tin Likely: Eng. and Min. Jour., vol. 125, No. 17, Apr. 28, 1928, pp. 685–689.

One of the outstanding developments of the year was the progress made by the Tin Producers' Association. This organization, formed during the summer of 1928, did not obtain a substantial membership or begin its major activities until the close of that year. Its purpose was the stabilization of the price of tin, an end which it proposed to accomplish by production control, by research for new uses, and by publicity programs. Its greatest efforts were directed toward curtailment of production to offset the decline in consumption and the large and rising "visible" stocks. An energetic campaign pointing out the high cost of tin production and the results to be obtained by production curtailment was conducted. Several plans were proposed to its members, but it was soon found that no one plan for curtailment of production was applicable to the mines of all its members. Some of the various plans were: (1) To close all operations on Sundays; (2) to close for a week, a month, or two months; (3) to limit the year's (1930) production to 80 per cent of that for 1929; (4) to close the less efficient units at each property; (5) to work only lean ore; and (6) to pool tin stocks at the smelters. However, in spite of the efforts of the association, the "visible stocks" continued to rise and the price to fall. Unconvinced that others would curtail production the members refused to make the sacrifices asked until assured of complete cooperation. Many companies had but one dredge and could not follow the plan to discontinue production from one unit. Others lacked funds to finance operations in any but the best ore at maximum capacity. Some of the companies that could produce tin at very low cost thought it unfair that they should sacrifice profits to benefit the high-cost producers. It seemed unreasonable to hope to save companies that had been financed on the assumption that tin always would sell for a minimum of £200 to £250 a ton. As the association continued its efforts the falling price of tin proved an increasingly powerful ally in effecting curtailment.

In its campaign the Tin Producers' Association naturally emphasized the improved price level that it believed the success of the plan would assure. It is thus not improbable that many high-cost producers were induced to continue production in spite of the losses involved.

The present period is one of consolidation of producers, of diminished prospecting and development, and of less urgent need of replacing tin with substitutes. It is not improbable that these factors will be conducive to reaction to a higher price level, as they have been in the past.

The research activities of the Tin Producers' Association have not yet resulted in the publication of any important findings. This work and the attempt to improve the statistics of the industry are without doubt the most constructive measures that the association has proposed to undertake.

Another important development of the year was the formation of Consolidated Tin Smelters (Ltd.), an amalgamation of the tin-smelting business of Williams, Harvey & Co. (Ltd.), Eastern Smelting Co., Cornish Tin Smelting Co., and Penpoll Tin Smelting Co. This consolidation brought virtually all the tin smelting in the British Isles under one management and included more than one-fourth of the smelter capacity of the Straits Settlements. The total annual capacity of its smelters is about 100,000 long tons of tin or one-half of the total tin-smelter capacity of the world.

This company's smelter capacity, together with that of the Straits Trading Co. and the Netherland East Indies smelter, accounts for more than 90 per cent of the world total.

Estimates of the reserves [4] of tin in the world have ceased to draw the attention they did when the price was at higher levels, but during a period of suspended prospecting and development it is well to consider what may be expected beyond the immediate future. In studying the available reports of tin-producing companies it was found that two-thirds of the world's total tin output is derived from alluvial deposits and one-third from lode deposits, and that one-fourth of the total is from properties that report their proved ore reserves. Producing alluvial properties reporting reserves have deposits that promise an average of 21 years' production at the 1928 rate; producing lode deposits reporting reserves have ore blocked out for an average of 5 years' production. The three-fourths of the total that comes from properties that do not publish their reserves is probably from mines that are less well supplied with reserves, but which may be counted upon to maintain present production for some time to come. The difference in assured life between alluvial and lode properties does not necessarily indicate that lode mines will be the first to become exhausted, but shows a difference in the methods, cost, and necessity of proving reserves. In fact, it seems probable that tin mining will follow the course of gold mining and will depend less and less upon alluvial deposits. Such deposits are limited to very shallow depths and are subject to easy discovery and relatively complete and rapid exploitation. When they are exhausted there is no alternative of mining at greater depths or searching for parallel deposits. Only by a continual search for and development of new deposits can the world's tin requirements be filled in the more distant future.

DOMESTIC PRODUCTION

Although the United States has never been an important producer of tin it does not lack producing deposits altogether; nevertheless, careful studies of areas where tin has been produced or where it has been found, particularly during the World War period, indicate that this country can not expect to supply even an appreciable part of its requirements. The following table gives the domestic mine production for the last 10 years.

Tin mined in the United States (including Alaska), 1920–1929, in long tons

[Metallic tin obtainable from concentrates produced in tin mining]

1920	20	1925	12.3
1921	3.6	1926	7.14
1922	1.3	1927	24
1923	1.7	1928	42
1924	6.3	1929	35

Smelter output of metallic tin in the United States, 1920–1929, in long tons

1920	15,761	1923	6,666
1921	10,305	1924	434
1922	8,132	1925–1929	------

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[4] Merrill, Charles White, World Reserves and Resources of Tin: Inf. Circ. 6249, Bureau of Mines, 1930, 8 pp.

ALASKA

According to the United States Geological Survey tin-ore concentrates produced in Alaska in 1929 contained 34.5 long tons of tin, compared with 36.6 tons in 1928 and 23.9 tons in 1927. The placers near York on the Seward Peninsula, about 100 miles north of Nome, were the principal producers. Prospecting and development work, with some production of tin ore, continued in the Hot Springs, Ruby, and Big Creek districts of the Yukon Valley. The tin concentrates produced in Alaska were shipped to Seattle, whence they were exported to the Straits Settlements for smelting.

CALIFORNIA

The first recorded discovery of tin in what is now the United States was made in 1840, in San Bernardino County, near Colton, Calif., about 60 miles due east of Los Angeles. The total estimated production for this district since its discovery is about 100 short tons. The mines had been idle for many years, but a company reopened some of them in 1928 and produced ore containing 3.6 long tons of tin. In 1929 the ore produced carried 0.4 ton of tin.

SOUTH DAKOTA

During 1929 South Dakota produced concentrates containing 0.22 long ton of tin, compared with 1.8 tons in 1928. The production was derived from lode-tin deposits in the Tinton and Harney Peak areas of the Black Hills.

OTHER STATES

No other tin production was reported in the United States in 1929. There are, however, areas in Virginia, North Carolina, South Carolina, and Texas that have produced small quantities in the past, and tin minerals are known to occur in many other States.

SECONDARY TIN

The quantity of secondary tin recovered in the United States during 1929 was 30,625 long tons, a decline of 4 per cent from that recovered in 1928, and was equivalent to 35 per cent of the virgin tin imported in 1929. If the recovery of secondary tin were included with primary production, the United States would rank third among the tin-producing countries of the world. The recovery of secondary tin, as metal, in alloys, and in chemical compounds, in the United States during the last 10 years has been as follows:

Secondary tin recovered as metal and in alloys and chemical compounds in the United States, 1920–1929 [1]

Year	Long tons	Value	Year	Long tons	Value
1920	20,982	$22,705,700	1925	27,634	$35,165,400
1921	15,089	9,668,500	1926	29,821	42,511,500
1922	17,420	12,443,500	1927	32,946	46,302,100
1923	26,973	25,316,000	1928	31,964	35,678,300
1924	27,946	31,062,100	1929	30,625	30,513,300

[1] Figures compiled by J. P. Dunlop, of the Bureau of Mines.

The quantity of secondary tin recovered fluctuates with industrial activity and the price of virgin tin. One of the principal sources of secondary tin is scrap resulting from the manufacture of tin-bearing articles. The value of this type of scrap and of reclaimed junk depends upon the prices offered for the metals contained.

Tin-bearing alloys, tin-plate clippings, and melting-pot drosses are the most important materials from which tin is reclaimed. Most of the tin recovered from alloys does not pass through a refined-tin stage but is made into alloys which are brought to the required specifications by the addition of virgin metals.

Most of the tin plate entering the reclaiming processes is composed of trimmings incidental to the fabrication of tin-plate products. In the past some used tin cans have entered the detinning plants but, at the present prices for reclaimed metals, the recovery of tin from this source is unprofitable in the United States. Some recovery of tin from used cans was reported[5] in Great Britain during 1929.

At present the leading method used for tin recovery from tin plate is the chlorine process, which involves the exposure of clean, dry tin plate to dry chlorine gas. The tin is recovered as the chloride, much of which enters as such into the silk, pigment, and ceramic industries. The tin-free steel scrap residue is well suited for charging into basic open-hearth steel furnaces. The alkali method of detinning is also widely employed. In applying this method clean tin plate is treated in a lye solution which removes the tin coating. The tin is finally recovered as pig tin of high purity, and the steel scrap is disposed of as in the chlorine process. The electrolytic method of detinning is also used to some extent.

In a recent article[6] tartaric acid is proposed as a substitute for lye in a process otherwise much like the alkali detinning process described above. So far this method has not passed beyond the laboratory stage.

IMPORTS AND EXPORTS

METAL AND ORE

The smelting of imported tin concentrates in the United States began in 1916. Tin concentrates were first imported for smelting in the United States in 1915, reached the high point both in quantity and value in 1920, and virtually ceased in 1924. The tin content of concentrates imported since 1924 has ranged from 122 to 303 long tons and was 128 tons in 1929. Inability to obtain clean concentrates to mix with the foul Bolivian concentrates ended the United States tin-smelting industry, at least temporarily. The enormous local market, coupled with the proximity of Bolivia, should allow the United States to build up a large tin-smelting industry if a process for handling Bolivian concentrates economically, without admixture of clean ore, could be devised.

The small quantity of concentrates produced in Alaska is shipped to Seattle, whence it is exported to the Straits Settlements for smelting.

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[5] New York Times, Value of Old Tin Cans Is Discovered in Britain: Oct. 20, 1929, p. X17.

[6] Scott, Wilfred W., and Davis, Nele E., Detinning of Scrap Tin Plate: Ind. and Eng. Chem., vol. 22, No. 8, August, 1930, p. 910.

Tin concentrates imported into the United States, 1920–1929

[General imports]

Year	Long tons	Value	Year	Long tons	Value
1920	30,489	$18,795,162	1925	[1] 191	$98,489
1921	13,696	5,672,861	1926	[1] 303	187,396
1922	12,325	5,504,434	1927	[1] 122	79,089
1923	2,692	2,169,055	1928	[1] 130	69,227
1924	[1] 155	71,094	1929	[1] 128	66,609

[1] Recorded as tin content.

Tin content of tin ore, cassiterite, and black oxide of tin imported into the United States, 1928 and 1929, by countries

[General imports]

Country	1928		1929	
	Long tons	Value	Long tons	Value
Bolivia	46	$20,219	6	$2,442
Canada	84	49,008	121	63,484
China			(1)	30
United Kingdom			1	653
	130	69,227	128	66,609

[1] Less than 1 ton.

Metallic tin imported for consumption in the United States, 1920–1929

Year	Long tons	Value	Year	Long tons	Value
1920	56,067	$73,440,872	1925	76,646	$95,121,111
1921	24,197	16,645,719	1926	77,159	104,793,396
1922	60,193	40,797,986	1927	71,142	100,865,205
1923	68,934	61,092,354	1928	77,970	86,983,174
1924	65,059	68,953,193	1929	87,127	91,838,781

Metallic tin (bars, pigs, blocks, grains, and granulated) imported into the United States, 1928 and 1929, by countries

[General imports]

Country	1928		1929	
	Long tons	Value	Long tons	Value
Australia	766	$845,978	590	$628,889
Canada	17	16,937	12	10,078
China	50	60,077	365	350,187
Cuba	25	29,839		
Germany	1,799	2,018,366	566	599,375
Guiana (British)	25	26,666		
Hong Kong	2,174	2,487,924	3,088	3,185,950
India (British)	1,035	1,142,543		
Japan	100	101,196		
Java and Madura	338	401,264	270	292,983
Malaya (British) (Straits Settlements)	52,291	58,334,442	58,219	61,322,731
Netherlands	7,153	8,229,377	7,522	8,216,715
United Kingdom	12,197	13,288,565	16,494	17,231,435
Virgin Islands of the United States			1	438
	77,970	86,983,174	87,127	91,838,781

Metallic tin exported from the United States, 1920–1929, in long tons

Year	Domestic [1]	Foreign [2]	Year	Domestic [1]	Foreign [2]
1920	630	297	1925	361	571
1921	1, 030	363	1926	675	1, 305
1922	804	294	1927	1, 010	1, 229
1923	750	296	1928	349	1, 268
1924	419	540	1929	790	1, 140

[1] Imported as ore and exported as pigs, bars, etc.
[2] Imported as pigs, bars, etc., and exported as such.

The quantity of tin (bars, pigs, blocks, grains, and granulated) imported into the United States in 1929 was the largest on record, amounting to 87,127 long tons, compared with 77,970 tons in 1928 and 71,142 tons in 1927. The import value ($91,838,781), though exceeding that in 1928, is smaller than that in any other year since 1924. Of the tin imported in 1929, 67 per cent was from the Straits Settlements, 19 per cent from the United Kingdom, nearly 9 per cent from the Netherlands, nearly 4 per cent from Hong Kong, and the remainder from some six other countries. The proportion of the total imports supplied by the Straits Settlements and the Netherlands remained the same as in 1928, but that supplied by the United Kingdom increased from 16 per cent of the total in 1928 to 19 per cent of the total in 1929.

The exports of metallic tin, though relatively small, increased from 1,617 long tons in 1928 to 1,930 tons in 1929.

TIN MANUFACTURES

The imports of tin plate, terneplate, and taggers tin in 1929 amounted to 285 long tons, valued at $71,824, compared with 922 tons, valued at $152,608, in 1928. Of the total in 1929, 87 per cent came from the United Kingdom and virtually all the remainder from Canada.

Tin plate, terneplate, and taggers tin imported into the United States, 1928 and 1929, by countries and by districts

	1928		1929	
	Long tons	Value	Long tons	Value
COUNTRY				
Belgium	7	$150		
Canada	39	10, 563	38	$9, 703
France	(1)	4		
Germany	94	6, 627	(1)	25
Paraguay	4	1, 057		
Soviet Russia in Europe			(1)	25
United Kingdom	778	134, 207	247	62, 071
	922	152, 608	285	71, 824
DISTRICT				
Buffalo	6	1, 662		
Chicago			(1)	8
Los Angeles	2	533	6	1, 838
Massachusetts	12	3, 015	28	6, 512
Michigan			16	3, 711
New York	113	14, 255	30	6, 150
Ohio	32	8, 287	9	2, 180
Oregon	10	1, 103	7	1, 971
Philadelphia	80	22, 723	70	18, 035
Pittsburgh	(1)	14		
St. Lawrence	36	9, 770	10	2, 773
San Francisco	488	53, 776	5	1, 372
Vermont	15	3, 794	50	12, 219
Washington	1	433	1	368
Wisconsin	127	33. 243	53	14, 687
	922	152, 608	285	71, 824

[1] Less than 1 ton.

The exports of tin plate, terneplate, and taggers tin amounted to 258,964 long tons, valued at $28,566,189, in 1929, compared with 249,642 tons, valued at $26,345,576, in 1928. The quantity exported in 1929 exceeded that in any previous year but the total value was a little below that in 1927. The countries receiving the larger part of the exports in 1929 were as follows: Japan, $6,987,765; Canada, $5,533,681; China, $3,987,781; Argentina, $2,103,021; Mexico, $1,184,769; India, $1,103,118; and the Philippine Islands, $916,509. Large increases in exports to the Orient, principally to China, Japan, Soviet Russia in Asia, and the Philippine Islands, accounted for much of the total increase. There were declines in exports to Brazil, Italy, India, Mexico, and Canada.

Much tin also is exported from the United States in products which derive but little of their value from their tin content. The most important of such exports are products of the automotive industry and of the food-packing industry. There are no statistics on the quantity of tin thus exported, but estimates based on the total exports of these products indicate that it is considerable.

Tin plate, terneplate, and taggers tin exported from the United States, 1928 and 1929, by countries and by districts

	1928		1929	
	Long tons	Value	Long tons	Value
COUNTRY				
North America:				
Barbados	-----------	-----------	37	$2,602
Canada	48,342	$5,786,247	46,213	5,533,681
Central America—				
Costa Rica	77	8,563	11	1,623
Guatemala	55	6,383	62	7,470
Honduras	1	205	1	169
Nicaragua	7	841	6	849
Panama	7	1,148	4	591
Salvador	48	6,785	18	2,440
Mexico	13,922	1,224,351	10,901	1,184,769
Miquelon and St. Pierre Islands	-----------	-----------	41	3,997
Newfoundland and Labrador	154	15,970	101	10,109
West Indies—				
British—				
Jamaica	48	5,132	22	2,449
Trinidad and Tobago	-----------	-----------	130	13,369
Other	7	705	-----------	-----------
Cuba	4,073	430,535	5,517	597,224
Dominican Republic	20	2,931	17	2,232
Haiti	10	1,335	4	494
Netherland	399	40,077	394	41,625
South America:				
Argentina	22,460	2,166,411	20,687	2,103,021
Bolivia	-----------	-----------	9	964
Brazil	9,993	936,030	3,927	389,229
Chile	4,823	497,769	5,670	589,957
Colombia	1,905	197,361	1,033	119,951
Ecuador	5	767	5	888
Guiana, Netherland (Surinam)	1	135	115	11,339
Peru	4,956	431,646	6,413	675,162
Uruguay	4,600	429,512	4,743	482,725
Venezuela	309	32,344	167	18,156
Europe:				
Belgium	625	58,721	21	2,168
Bulgaria	155	17,169	34	3,764
Denmark	903	82,112	297	29,830
Finland	41	3,871	-----------	-----------
France	95	9,949	5	695
Germany	11	785	-----------	-----------
Greece	2,506	236,562	3,145	340,406
Italy	9,169	943,094	5,688	620,486
Latvia	1	68	-----------	-----------
Lithuania	9	838	-----------	-----------
Netherlands	297	27,277	116	11,239

Tin plate, terneplate, and taggers tin exported from the United States, 1928 and 1929, by countries and by districts—Continued

	1928		1929	
	Long tons	Value	Long tons	Value
COUNTRY—continued				
Europe—Continued.				
Norway	1,545	$144,642	13	$1,251
Portugal	117	12,175	60	6,203
Rumania	96	9,842		
Soviet Russia	991	103,281	1,133	155,960
Spain	189	20,185		
Sweden	1,135	109,600	497	48,464
Switzerland	36	3,546		
United Kingdom	242	25,091	155	17,538
Asia:				
Ceylon	73	7,478	92	10,220
China	28,727	3,032,794	37,734	3,987,781
East Indies—				
British—				
India	13,017	1,361,707	10,034	1,103,118
Malaya (Straits Settlements)	1,203	126,767	1,932	212,058
Netherland	556	55,369	694	76,776
French Indo-China	29	3,100		
Hong Kong	2,412	257,528	5,316	526,527
Iraq			(1)	57
Japan (including Chosen)	55,988	6,092,237	61,811	6,987,765
Java and Madura	2,572	262,890	2,821	307,270
Kwantung	143	10,255	134	12,028
Palestine	17	1,863	52	4,141
Philippine Islands	5,582	602,077	8,661	916,509
Soviet Russia	47	6,102	3,005	402,036
Syria	108	11,187	1,005	103,112
Turkey	1,323	145,407	3,023	333,190
Africa:				
British—Union of South Africa	505	50,166	567	58,584
Egypt	2,948	286,022	4,658	487,588
Portuguese—				
Mozambique	6	448		
Other	1	120		
Oceania (British):				
Australia			12	2,190
New Zealand	(1)	68	1	150
	249,642	26,345,576	258,964	28,566,189
DISTRICT				
Alaska	(1)	23		
Arizona	17	1,991	62	6,372
Buffalo	26,418	3,145,020	29,782	3,605,420
Chicago	1,652	201,564	864	98,311
Dakota	2,706	332,196	2,163	255,716
Duluth and Superior	249	32,160	383	42,671
El Paso	5	1,253	2	350
Hawaii	684	59,320		
Los Angeles	22	1,925	225	9,194
Maine and New Hampshire	527	59,074	180	20,542
Maryland	107,483	11,310,861	91,048	9,781,644
Michigan	730	90,284	1,227	136,454
Mobile	100	7,511		
New Orleans	643	54,895	110	8,677
New York	85,120	8,355,159	99,735	10,951,736
Ohio	13,882	1,690,807	8,780	1,074,302
Oregon	50	3,855	150	11,548
Philadelphia	6,199	660,813	17,752	1,856,088
Rochester	1	206	1	287
Sabine			(1)	28
St. Lawrence	1,145	120,827	928	97,128
San Antonio	577	58,658	781	87,730
San Francisco	415	42,354	1,797	163,238
Vermont	2	854	951	108,859
Virginia	4	518	30	3,764
Washington	1,011	113,448	2,013	246,130
	249,642	26,345,576	258,964	28,566,189

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[1] Less than 1 ton.

CONSUMPTION

The United States is the world's leading consumer of tin. Supremacy in the canning and motor-vehicle industries is the most important factor in the position of America among tin consumers. The Bureau of Mines canvassed the domestic tin-consuming industries to ascertain their consumption and stocks of virgin tin in 1927 and 1928.[7] The results of this work are presented in the following table and text. As the earlier estimates of the War Industries Board (1917) and the Bureau of Mines (1925)[8] included secondary tin, they are not comparable with the following figures.

Virgin tin consumed in the United States, 1927 and 1928, by uses

Use	1927		1928	
	Long tons	Per cent of total	Long tons	Per cent of total
Tin plate and terneplate	24, 525	35. 96	27, 053	36. 92
Solder	13, 602	19. 94	13, 483	18. 40
Babbitt	7, 595	11. 14	7, 851	10. 72
Bronze	4, 664	6. 84	4, 296	5. 86
Foil	4, 193	6. 15	[1] 5, 068	6. 92
Collapsible tubes	2, 710	3. 97	[1] 2, 864	3. 91
Chemicals	2, 620	3. 84	4, 246	5. 79
Tin oxide	1, 311	1. 92	1, 183	1. 61
Tinning (brass, copper tubes, sheets, shells, wire, nails)	2, 661	3. 90	2, 636	3. 60
White metal	849	1. 25	802	1. 09
Type metal	450	. 66	400	. 55
Castings	1, 011	1. 48	730	1. 00
Other alloys	557	. 82	629	. 86
Miscellaneous	1, 450	2. 13	2, 028	2. 77
	68, 198	100. 00	[1] 73, 269	100. 00

[1] Revised figures.

The consumption of secondary tin can not be segregated by various uses to the extent that the consumption of the virgin metal can. Only about one-fourth of the total secondary tin is recovered as metallic tin before reuse, and much of the consumption is of alloys by companies who are unable to report the exact tin content of the tin-bearing secondary materials they consume. The Bureau of Mines inquiry on consumption of tin in 1928 accounted for the use of more than 12,000 tons of secondary metallic tin, chiefly in the manufacture of solder, babbitt, bronze, chemicals, and type metal. The tin-alloy store of the United States can best be represented as a reservoir, containing many metals, into which a stream of virgin tin must constantly flow to replace losses and provide for expansion. The quantity of virgin tin required for the manufacture of the common tin-bearing alloys, including solder, babbitt, bronze, etc., and white metal and type metal amounted to 27,717 long tons in 1927 and 27,461 tons in 1928 out of a total of 68,198 tons in 1927 and 73,269 tons in 1928. The principal use of secondary tin, however, is in the manufacture of such alloys, and most of the tin recovered from alloys and reused does not pass through the pure metallic state during the process of recovery. The alloy scrap is sorted to remove undesirable elements, is melted and analyzed, and then receives sufficient virgin metals to bring the molten mass to the analysis desired.

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[7] Umhau, J. B., Consumption of Primary or Virgin Tin in the United States, 1927: Inf. Circ. 6084, Bureau of Mines, 1928, pp. 1–2. Umhau, J. B., Consumption of Primary or Virgin Tin in the United States, 1928; Inf. Circ. 6165, Bureau of Mines, 1929, 8 pp.

[8] Furness, J. W., Consumption of Tin in the United States, 1925: Inf. Circ. 6019, Bureau of Mines, 1927 pp. 1–3.

Much of the tin requirement of the chemical industries is met by the use of tin oxide, tin chloride, and other chemical compounds made from tin scrap and tin drosses. The chemical industries (exclusive of tin oxide manufacture) required, however, 2,620 long tons of virgin tin in 1927 and 4,246 tons in 1928. The manufacture of tin oxide required 1,311 long tons of virgin tin in 1927 and 1,183 tons in 1928.

The quantity of virgin tin consumed in the foil industry increased from 4,193 long tons in 1927 to 5,068 tons in 1928. The requirements for collapsible tubes also increased, from 2,710 long tons in 1927 to 2,864 tons in 1928.

The estimating of consumption of virgin tin by calculations based on production, imports, exports, and change in visible stocks is not dependable, as stocks held by consumers and dealers are unknown, and failure to account for them might affect the totals greatly, yet such calculations are not entirely without interest to the trade as they show what is often called "apparent" consumption. Apparent consumption in 1929 increased about 12 per cent over that in 1928. It may be noted, however, that production of tin plate and terneplate failed to show as large an increase, but that the number of automobile units showed an increase almost double the indicated increase in consumption of tin.

TIN PLATE AND TERNEPLATE

The tin-plate and terneplate industry is the largest consumer of virgin tin in the United States, having consumed more than one-third of the total virgin tin used in 1927 and in 1928. The volume of tin plate and terneplate produced in 1929 indicates that almost the same proportion of virgin tin continued to enter this industry.

Tin plate is made by coating steel sheets with pure tin, and in present practice standard tin plate contains about 1½ per cent of tin by weight. One pound of tin will make 220 square feet of tin plate. Terneplate is similar to tin plate, except that an alloy of lead and tin is substituted for pure tin in the coating. Taggers tin is extra-thin tin plate. The larger part of the tin plate and taggers tin manufactured is used for making tin cans, particularly food containers. Terneplate is largely used for roofing and for gasoline tanks on automobiles, and some is substituted for tin plate in nonfood-product containers, where the toxic effect of the lead is not deleterious.

In 1929 tin was used in the manufacture of 1,816,223 long tons of tin plate and 152,057 tons of terneplate in the United States, compared with 1,714,990 and 124,215 tons, respectively, in 1928. Exports of tin plate, terneplate, and taggers tin amounted to 258,964 long tons in 1929, an increase over the 249,642 tons exported in 1928. Imports declined from 922 long tons in 1928 to 285 tons in 1929. The United States produces nearly twice as much tin plate and terneplate as the United Kingdom but exports only about one-half as much as that country.

Tin plate and terneplate produced in the United States, 1920–1929, in long tons[1]

Year	Tin plate	Terneplate	Total	Year	Tin plate	Terneplate	Total
1920	1,374,979	70,566	1,445,545	1925	1,544,007	113,788	1,657,795
1921	747,911	46,363	794,274	1926	1,674,322	107,984	1,782,306
1922	1,208,772	79,123	1,287,895	1927	1,583,383	105,066	1,688,449
1923	1,414,404	92,458	1,506,862	1928	1,714,990	124,215	1,839,205
1924	1,328,228	90,426	1,418,654	1929	1,816,223	152,057	1,968,280

[1] From Annual Report of American Iron and Steel Institute.

AUTOMOBILE MANUFACTURE

The automobile industry consumes a quantity of tin equivalent to almost one-fourth of that imported. According to the National Automobile Chamber of Commerce [9] 21,000 tons of tin was consumed by this industry in 1929, compared with 19,000 tons in 1928 and 16,000 tons in 1927. The number of motor vehicles produced in 1929 was the highest in history, showing an increase of a million units, or 23 per cent, over 1928, but a sharp decline in production in 1930 is expected. The chief uses of tin in automobile manufacture are in babbitt for engine bearings, solder for radiators, and bronzes for bearings and bushings.

The number of motor vehicles registered in 1929 was five times the number of new units manufactured, and their maintenance and repair are a very substantial factor in the consumption of tin. Although there are no adequate figures upon which to base exact conclusions it is undoubtedly safe to state that radiators and babbitt bearings require a larger percentage of repairs and replacements than most other metallic parts of the average motor vehicle. In this connection it may be noted that the universal use of pumps for circulating oil in the crankcase and water in the radiator in the current models should decrease the use of tin replacements and repairs. These refinements in design, together with economies in the initial use of tin, may actually decrease the future requirements of tin in spite of probable increasing motor-vehicle use and production.

Production, registration, and exports of motor vehicles in the United States, 1922–1929

Year	Production [a]			Registration [b] (all classes)	Exports [c] (all classes)
	Passenger cars	Trucks and busses	Total		
1922	2,274,185	269,991	2,544,176	12,421,000	78,234
1923	3,624,717	409,295	4,034,012	15,264,000	151,894
1924	[d] 3,185,881	416,659	3,602,540	[e] 17,748,000	178,732
1925	[d] 3,735,171	530,659	4,265,830	[e] 20,078,000	302,931
1926	[d] 3,783,987	516,947	4,300,934	[e] 22,133,000	305,420
1927	[d] 2,936,533	464,793	3,401,326	[e] 23,254,000	384,195
1928	[d] 3,815,417	543,342	4,358,759	[e] 24,611,000	507,097
1929	[d] 4,587,400	771,020	5,358,420	[e] 26,616,000	536,201

[a] Bureau of the Census.
[b] Bureau of Public Roads.
[c] Bureau of Foreign and Domestic Commerce.
[d] Includes taxicabs.
[e] Includes road tractors, not previously reported.

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[9] Facts and Figures of the Automobile Industry: New York, editions 1928, 1929, and 1930, p. 83 (1928 ed.), p. 13 (1929 ed.), and p. 83 (1930 ed.).

Smaller but increasingly important users of tin and its alloys are the manufacturers of airplanes, motorships, and stationary Diesel engines. All of these products require tin in their manufacture and for much the same purposes as do automobiles. The rapidly increasing manufacture of electric refrigerators should prove an outlet of growing importance for tin, as these products utilize heavily tinned racks and trays as well as much tin in the refrigerating units.

SUBSTITUTES

The widespread opinion that the reserves of tin, marketable at about current prices, are very limited encouraged for many years research for substitutes. The relatively high price of tin in comparison with that of most of the common metals proved an added incentive to substitution. The falling price during 1929, however, has greatly decreased the interest in substitution, except of those who object to dependence upon a metal that must be supplied almost solely by importation. As a result much of the research directed toward the development of tin substitutes has made available products and processes which should protect domestic industry to some extent in case of exorbitant prices or interrupted importation but which are uneconomical at present tin prices.

Much study has been given the problem of finding a substitute for tin plate in the canning industry, but to date no tin-free container has been developed that can offer serious competition to the tin can. Glass containers have been used successfully where the advantage of display of contents has outweighed the higher initial cost and difficulties of transportation. Experiments have been made with stainless steel cans, but the high cost and the difficulties of opening have made their use uneconomical. Research to develop a practical aluminum can continues. So far the aluminum products have been not only costly but have failed to resist the rough handling to which the ordinary can is subject. Research in the substitution of lacquers for tin in the manufacture of tin cans has made little progress because of the difficulty in obtaining an appearance of cleanliness and beauty equal to that of the tin as well as the difficulty in duplicating the purely utilitarian qualities of the tin coating.

In the manufacture of alloys the aluminum brasses have displaced some of the tin-bearing bronzes, but in the making of other bearing metals and solders the displacement of tin seems to have been of little importance. The savings effected have depended upon a more economical use of the alloys. Attention has been given to decreasing the amount of tin alloy entering bearings, and joints to be soldered are being fitted more carefully to avoid unnecessary filling in with solder.

Aluminum is being used as a substitute for tin in the manufacture of foils and collapsible tubes. The fields where lead is excluded because of its toxic properties are now being invaded by aluminum. Because of its low specific gravity a given weight of aluminum will make much more foil of a given gage than an equal weight of tin, but this advantage is offset in some tin foils by rolling from bars containing a lead core. Tin foil is also meeting severe competition as a food and cigar wrapper in "cellophane," a transparent cellulose product, and in various waxed papers.

The further introduction of ball and roller bearings, particularly in railroad rolling stock, has cut into fields once held almost exclusively by babbitt and related bearing metals.

The substitution of rayon for silk tends to lessen the use of tin, as rayon, unlike silk, does not require the use of tin salts in preparation for dyeing and in weighting.

PRICES[10] AND STOCKS

The break in the tin market that started in April, 1927, continued with only minor recoveries until a low monthly average of 39.79 cents a pound was reached in December, 1929. The high monthly average for 1929 of 49.37 cents was for February, the low of 39.79 cents was for December, and the average for the year was 45.19 cents, compared with a high for 1928 of 55.64 cents for January, a low of 47.10 cents for July, and an average 50.46 cents for the year. The average price for the year 1929 was thus 5.27 cents, or 10 per cent, less than the average for 1928.

Monthly price of Straits tin for prompt delivery in New York, 1927–1929, in cents per pound [1]

	1927			1928			1929		
	High	Low	Average	High	Low	Average	High	Low	Average
January	67.62½	64.87½	66.47	57.75	54.25	55.64	49.87½	48.50	49.16
February	71.00	66.50	69.06	54.50	51.12½	52.49	50.37½	48.80	49.37
March	70.50	68.00	69.31	53.87½	50.25	52.18	49.62½	48.37½	48.85
April	70.00	66.12½	68.02	53.87½	51.12½	52.36	48.75	43.75	45.97
May	68.50	66.62½	67.52	52.50	49.87½	51.54	44.62½	43.37½	43.92
June	68.25	66.00	67.42	49.75	45.75	47.96	44.75	43.50	44.26
July	65.75	63.37½	64.06	49.00	46.00	47.10	47.50	44.70	46.40
August	65.62½	63.50	64.47	48.87½	47.25	48.08	47.37½	46.12½	46.65
September	63.75	57.87½	61.49	49.75	47.00	48.07	45.87½	45.00	45.38
October	59.50	57.50	58.50	50.00	48.25	49.01	44.25	40.37½	42.35
November	59.12½	56.12½	57.63	53.00	49.25	50.85	41.87½	39.12½	40.22
December	59.37½	57.75	58.49	53.25	49.37½	50.21	41.75	38.37½	39.79
Year	71.00	56.12½	64.37	57.75	45.75	50.46	50.37½	38.37½	45.19

[1] Metal Statistics, 1930, pp. 351 and 353.

Although an average price of 45.19 cents a pound for 1929 may seem low when compared with the prices prevailing during the years immediately preceding, it may be noted that the price since 1900 has averaged nearly 2 cents below that level.

The following table shows tin-plate, pig-tin, and sheet-bar tin price changes since 1920 on the dates listed.

Changes in prices for tin plate at Pittsburgh, pig tin at New York, and sheet-bar tin at Pittsburgh, 1920–1929 [a]

Date	Tin plate (per base box)	Pig tin (per pound)	Sheet bars (per long ton)	Date	Tin plate (per base box)	Pig tin (per pound)	Sheet bars (per long ton)
		Cents				*Cents*	
1920: Dec. 2	$7.00	34.00	$47.00	1924: Nov. 25	$5.50	54.375	$37.00
1921:				1925: Nov. 19	5.50	63.50	35.00
Apr. 13	6.25	29.25	39.00	1926: Nov. 9	5.50	71.00	36.00
June 14	5.75	29.375	39.00	1927: Nov. 30	5.25	58.625	34.00
July 29	5.25	26.625	32.00	1928: Nov. 15	5.35	50.125	34.00
Nov. 3	4.75	28.00	30.00	1929:			
1922: Nov. 23	4.75	36.00	36.50	Nov. 15	5.35	39.875	34.00
1923:				Dec. 31	5.25	39.75	34.00
Feb. 26	4.95	44.25	40.00				
Apr. 26	5.50	44.125	45.00				
Nov. 1	5.50	41.875	42.50				

[a] Metal Statistics, 1930, p. 153.

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[10] Prices used in this discussion refer to Straits tin in New York, as quoted in the American Metal Market and published in Metal Statistics, 1930, pp. 351 and 353.

The monthly average of the world's "visible supply" of tin has been as follows: 1926, 15,386 long tons; 1927, 14,925 tons; 1928, 18,392 tons; and 1929, 25,481 tons. The supply followed a fairly regular downward trend from the high yearly average of 24,682 tons for 1922 to the low monthly average of 13,352 tons for August, 1926. Stocks remained at about this figure until after April, 1928, when, with the exception of a drop in June, there was a steady increase to the end of 1928. During 1929 the visible stocks fluctuated between narrow limits until the end of November, when there was an increase of some 3,000 tons which carried the visible stocks to a total of 28,140 tons, the highest monthly average ever recorded. The visible supply held in the United States has averaged about 2,500 tons for many years, seldom dropping below 1,500 tons and seldom exceeding 5,000 tons. There were no important fluctuations during 1929.

The so-called invisible stocks of tin are exceedingly difficult to estimate, as they consist largely of stocks held by consuming manufacturing companies and by metal merchants and speculators. A study of the questionnaires forming the basis of the Bureau of Mines study of the tin consumption in 1928 indicates that manufacturing requirements rather than current price of the metal determine the stocks carried by consumers of virgin tin in the United States.

WORLD PRODUCTION AND RESOURCES

The world production of tin in 1929 was 185,000 long tons, compared with 178,396 tons in 1928, 159,678 tons in 1927, and 143,556 tons in 1926. Expanding production in the Federated Malay States and in Bolivia has accounted for most of the increase, but smaller increases in several of the less important tin-producing countries have also contributed to the world increase. A decline of about 5,000 tons in the Netherland East Indies between 1928 and 1929 was the most important decrease.

A more rapid exploitation of known deposits rather than new discoveries has been the principal cause of increased production. In the alluvial areas there has been a large increase in the number of dredges in operation, and these have shown considerable improvement both in quantity of material handled and per cent of extraction. The lode mines have been further modernized, and their ores have been subjected to concentrating processes that give higher extractions than in the past.

World production of tin (tin content of ore), 1925–1929, by countries, in long tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1925	1926	1927	1928	1929
Australia	3, 016	2, 860	3, 144	2, 890	2, 239
Belgian Congo	1, 060	1, 145	873	785	992
Bolivia [1]	32, 224	30, 061	35, 808	41, 409	46, 343
China [1]	8, 884	6, 509	6, 220	7, 033	6, 500
England—Cornwall	2, 339	2, 327	2, 593	2, 761	3, 271
India (British)	1, 616	2, 484	2, 447	1, 946	2, 650
Indo-China	582	551	699	796	829
Japan [2]	(3)	537	669	733	[4] 700
Malay States:					
Federated [1]	45, 926	45, 948	52, 180	61, 935	67, 042
Unfederated [1]	2, 146	1, 773	2, 047	2, 689	2, 325
Netherland East Indies	30, 697	32, 234	34, 487	35, 660	30, 586
Nigeria	6, 256	7, 417	8, 056	9, 132	10, 742
Portugal	559	758	695	678	[4] 500
Siam [5]	7, 862	7, 341	7, 813	7, 800	[4] 8, 000
Union of South Africa	1, 147	1, 111	1, 147	1, 249	1, 218
Other countries [6]	800	500	800	900	1, 000
	145, 114	143, 556	159, 678	178, 396	185, 000

[1] Exports.
[2] Smelter product.
[3] Less than 500 tons; included under "Other countries."
[4] Approximate production.
[5] Year ended Mar. 31 of year following that stated.
[6] Includes countries producing less than 500 tons.

World trade in metallic tin, 1928 and 1929, in long tons [1]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1928												
Shipments from:												
Straits	6, 567	8, 397	8, 005	6, 774	7, 735	8, 516	8, 707	9, 309	8, 310	7, 611	9, 922	7, 961
Australia	112	134	121	114	108	111	116	114	113	108	103	105
Banka and Billiton	1, 055	695	513	1, 619	1, 573	806	982	1, 032	1, 717	1, 126	1, 225	1, 650
China	293	61	167	17	29	10	------	------	116	427	301	680
Bolivia [2]	2, 736	2, 643	3, 204	2, 115	2, 607	2, 877	3, 522	2, 406	2, 979	3, 450	3, 366	3, 996
Nigeria [2]	689	593	770	625	1, 156	590	760	569	660	694	1, 048	856
	11, 452	12, 523	12, 780	11, 264	13, 208	12, 910	14, 087	13, 430	13, 895	13, 416	15, 965	15, 248
Deliveries to:												
United Kingdom	1, 667	1, 711	1, 859	1, 274	873	1, 691	1, 201	1, 415	1, 456	1, 422	3, 235	1, 236
United States of America	5, 415	5, 790	7, 960	7, 010	5, 335	6, 950	5, 545	7, 200	6, 885	6, 475	7, 145	7, 155
Continental Europe	2, 108	1, 498	1, 706	1, 494	1, 933	1, 778	1, 912	1, 917	1, 584	2, 101	1, 848	1, 806
All others	586	317	593	839	575	789	1, 031	1, 300	1, 141	149	351	446
	9, 776	9, 316	12, 118	10, 617	8, 716	11, 208	9, 689	11, 832	11, 066	10, 147	12, 579	10, 643
Visible supply:												
Total—												
Shipments (loading)	7, 927	9, 287	8, 806	8, 227	9, 394	9, 443	9, 805	10, 402	10, 256	9, 272	11, 451	10, 396
Afloat	2, 014	3, 120	2, 614	2, 855	2, 397	2, 484	2, 340	3, 490	2, 871	2, 283	1, 513	3, 785
Landing	2, 595	2, 085	1, 985	1, 600	2, 730	1, 919	2, 505	772	2, 290	4, 332	3, 195	2, 179
In warehouse	2, 708	3, 153	2, 181	2, 319	2, 543	2, 385	3, 372	3, 792	4, 507	5, 020	5, 908	8, 203
	15, 244	17, 645	15, 586	15, 001	17, 064	16, 231	18, 022	18, 456	19, 924	20, 907	22, 067	24, 563
By countries—												
United Kingdom—												
Afloat—												
Straits	936	620	855	305	1, 240	840	1, 302	1, 315	1, 105	1, 145	2, 748	571
Australia	67	86	93	56	43	46	98	72	76	56	45	40
Netherland East Indies	104	209	70	337	121	42	78	322	541	331	453	365
China	------	25	------	------	------	------	------	------	------	------	25	------
Stocks—All others	2, 535	3, 240	2, 088	1, 946	1, 565	2, 156	2, 999	2, 846	3, 289	4, 754	5, 500	7, 954
	3, 642	4, 180	3, 106	2, 644	2, 969	3, 084	4, 477	4, 555	5, 011	6, 286	8, 771	8, 930

[1] Compiled from monthly issues of Iron and Coal Trades Review.
[2] Calculated metallic tin content of ore and concentrates to the United Kingdom only.

World trade in metallic tin, 1928 and 1929, in long tons—Continued

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1928—Continued												
Visible supply—Contd.												
By countries—Contd.												
United States of America—												
Afloat	6,287	8,311	7,629	7,281	6,574	6,903	6,546	8,653	8,099	6,825	6,493	9,554
Stocks and landings	2,768	1,998	2,078	1,973	3,708	2,148	2,878	1,718	3,508	4,598	3,603	2,428
	9,055	10,309	9,707	9,254	10,282	9,051	9,424	10,371	11,607	11,423	10,096	11,982
Continental Europe—												
Straits	1,533	2,537	2,330	2,144	2,360	3,191	3,217	2,925	2,113	2,180	2,244	2,105
Netherland East Indies	1,014	619	443	959	1,453	905	904	605	1,193	1,018	956	1,546
	2,547	3,156	2,773	3,103	3,813	4,096	4,121	3,530	3,306	3,198	3,200	3,651
Total visible supply	15,244	17,645	15,586	15,001	17,064	16,231	18,022	18,456	19,924	20,907	22,067	24,563
1929												
Shipments from:												
Straits	8,394	7,788	8,145	8,950	9,139	8,713	7,906	8,978	6,608	8,274	10,174	8,950
Australia	120	109	107	101	96	89	88	90	95	90	90	80
Banka and Billiton	697	1,741	1,554	1,549	577	624	828	1,003	1,353	1,210	839	1,276
China	335	280	896	635	30	50	185	365	260	205	250	405
Bolivia [1]	3,180	3,039	1,566	5,124	3,804	5,190	3,354	3,261	4,080	3,366	3,315	4,062
Nigeria [1]	868	762	882	1,153	1,025	792	676	658	879	958	932	827
	13,594	13,719	13,150	17,512	14,671	15,458	13,037	14,355	13,275	14,103	15,600	15,600
Deliveries to:												
United Kingdom	1,252	754	1,326	1,597	1,491	1,674	1,780	1,198	1,514	1,676	2,758	1,861
United States of America	8,795	6,750	8,175	8,435	8,480	7,455	6,865	7,185	8,120	6,515	6,595	5,740
Continental Europe	2,237	1,879	2,254	2,413	2,532	2,015	1,947	1,665	2,486	2,092	2,106	2,145
All others	593	719	590	573	762	841	409	513	373	757	789	1,099
	12,877	10,102	12,345	13,018	13,265	11,985	11,001	10,561	12,493	11,040	12,248	10,845
Visible supply:												
Total—												
Shipments (loadings)	9,546	9,918	10,632	11,192	9,637	9,467	9,007	10,436	8,316	9,779	11,353	10,321
Afloat	3,817	4,408	4,695	3,394	2,915	2,238	2,381	3,373	3,421	2,572	2,091	1,980
Landing	2,266	2,812	1,998	2,635	3,149	2,955	2,590	2,455	2,281	2,092	1,772	3,209
In warehouse	8,608	9,264	9,307	9,132	9,064	9,091	9,811	10,136	10,538	11,137	9,955	12,630
	24,237	26,402	26,632	26,353	24,765	23,751	23,789	26,400	24,556	25,580	25,171	28,140
By countries—												
United Kingdom—												
Afloat—												
Straits	710	1,298	903	1,125	840	1,603	920	915	1,003	1,990	1,885	1,625
Australia	35	71	54	44	42	44	87	40	93	67	40	60
Netherland East Indies	52	832	1,028	816	244	78	214	298	104	42	84	98
Stocks—All others	8,263	8,769	8,755	8,164	8,749	8,226	9,314	9,733	10,340	10,509	9,677	13,019
	9,060	10,970	10,740	10,149	9,875	9,951	10,535	10,986	11,540	12,608	11,686	14,802
United States of America—												
Afloat	9,196	8,920	10,059	8,932	7,766	6,408	6,922	9,685	7,530	6,561	7,336	7,041
Stocks and landings	2,611	3,307	2,550	3,603	3,464	3,820	3,087	2,858	2,479	2,720	2,050	2,820
	11,807	12,227	12,609	12,535	11,230	10,228	10,009	12,543	10,009	9,281	9,386	9,861
Continental Europe—												
Afloat—												
Straits	2,514	2,400	2,347	2,450	3,144	2,883	2,513	2,098	1,758	2,494	3,229	2,315
Netherland East Indies	856	805	936	1,204	516	689	732	773	1,249	1,197	870	1,162
Others	------	------	------	15	------	------	------	------	------	------	------	------
	3,370	3,205	3,283	3,669	3,660	3,572	3,245	2,871	3,007	3,691	4,099	3,477
Total visible supply	24,237	26,402	26,632	26,353	24,765	23,751	23,789	26,400	24,556	25,580	25,171	28,140

Calculated metallic tin content of ore and concentrates to the United Kingdom only.

Tin shipped into the United States and nationality of bottoms in which shipped, 1928 and 1929, in long tons [1]

Country	Flag	1928	1929
Australia	United States (U. S. Shipping Board)	--------	44
	United States (Independent)	425	155
	British	307	402
	Dutch	4,001	--------
		4,733	601
Canada:			
Atlantic	United States (Independent)	--------	16
Pacific	do	378	70
	British	275	--------
		653	86
China	United States (U. S. Shipping Board)	--------	25
	United States (Independent)	2,250	2,210
	British	115	1,321
	Japanese	782	1,979
	Norwegian	25	--------
		3,172	5,535
Colombia	British	35	--------
England	United States (U. S. Shipping Board)	21	89
	United States (Independent)	450	20
	British	11,922	16,380
		12,393	16,489
Germany	German	1,935	1,721
	Japanese	--------	36
	Norwegian	10	--------
		1,945	1,757
India	United States (Independent)	--------	204
Japan	Japanese	10	125
Java	British	172	161
	Dutch	145	37
	Norwegian	--------	26
		317	224
Netherlands	Dutch	4,231	7,852
Philippine Islands	United States (Independent)	113	--------
Scotland	British	17	--------
Straits Settlements	United States (Independent)	30,122	29,243
	British	22,227	23,553
	Dutch	1,178	2,916
	Japanese	200	--------
	Norwegian	175	372
		53,902	56,084
Sumatra	British	--------	50
Wales	do	377	--------
	Dutch	120	29
		497	29
Summary	United States (U. S. Shipping Board)	21	158
	United States (Independent)	33,738	31,918
	British	35,447	41,867
	Dutch	9,675	10,834
	German	1,935	1,721
	Japanese	992	2,140
	Norwegian	210	398
		82,018	89,036

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[1] Division of Statistics, Bureau of Research, U. S. Shipping Board, Special Report B. R. 1596, June 3, 1930. Figures subject to revision.

REVIEW BY COUNTRIES

BRITISH MALAYA

The southern part of the Malay Peninsula, which is known as British Malaya, consists of three major political divisions—the Federated Malay States, the Straits Settlements, and the Unfederated Malay States. The Federated Malay States is the world's leading producer of tin ore; the Straits Settlements holds first place in smelter output of tin; and the Unfederated Malay States (taken together) ranked eighth among the tin-ore producers of the world in 1929.

Federated Malay States.—The Federated Malay States continued to increase its output, producing 67,042 long tons of tin in 1929, compared with 61,935 tons in 1928 and 52,180 tons in 1927, and setting a new record for one year's production of tin. The production in 1929 represents an increase of 21,094 tons, or 46 per cent, over that in 1926, the highest 4-year tonnage increase for any country in the history of tin production. The increase in 1929 was due largely to the increased output by dredging. Dredging began in British Malaya in 1912, when the Malayan Tin Co. introduced a bucket dredge. In 1920, 20 dredges were in operation and produced about 15 per cent of the total output for the year. Since 1920 the number of dredges and their output have increased rapidly, reaching 70 dredges and 12,501 tons in 1927, 89 dredges and 18,752 tons in 1928, and 105 dredges and 25,950 tons in 1929.[11] The proportion of total tin production mined by dredging was 39 per cent in 1929, compared with 30 per cent in 1928 and 24 per cent in 1927. The rapid increase in the size of dredges is indicated by the average output per dredge which has been as follows: 1927, 179 tons; 1928, 211 tons; and 1929, 247 tons.

Summary of Federated Malay States mining-method statistics, 1925–1929 [a]

	1925		1926		1927		1928		1929	
	Long tons	Per cent of total	Long tons	Per cent of total	Long tons	Per cent of total	Long tons	Per cent of total	Long tons	Per cent of total
Production:										
European-owned mines	20,000	44	20,216	44	21,234	41	30,348	49	41,565	62
Chinese-owned mines	25,926	56	25,731	56	30,945	59	31,587	51	25,476	38
	45,926	100	45,947	100	52,179	100	61,935	100	67,041	100
Dredges	9,070	20	9,143	20	12,501	24	18,752	30	25,950	39
Other placer mines	34,001	74	33,634	73	36,998	71	39,777	65	38,213	57
Lode mines	2,855	6	3,170	7	2,680	5	3,406	5	2,878	4
	45,926	100	45,947	100	52,179	100	61,935	100	67,041	100

NUMBER OF DREDGES AT END OF YEAR

	1925	1926	1927	1928	1929
Operating	42	50	70	89	105
Under construction	14	21	21	21	10
On order or proposed	35	41	23	9	8

[a] Based on data presented in Federated Malay States Report on the Administration of the Mines Department and on the Mining Industries, Kuala Lumpur, Annual.

[11] Federated Malay States, Report on the Administration of the Mines Department and on the Mining Industries for the year 1929.

Coincident with the shift toward dredge production has been the shift of production from Chinese-owned to European-owned mines. In 1929 European-owned mines contributed 62 per cent of the total Federated Malay States tin production, compared with 49 per cent in 1928 and 41 per cent in 1927. This changing proportion has been to a large extent due to the increasing production of dredges, which so far have been exclusively European-owned. European operators, because of their larger investments in lands and equipment, have not found it as easy to restrict production during periods of falling prices as have the Chinese.

The advance of mechanization during recent years is brought out by the fact that the number of individuals employed in the mining industry has decreased 3 per cent since 1925 while the horsepower of machinery so employed has increased 74 per cent, the net result being an increase of 46 per cent in production. At the same time the Chinese smelter has been virtually eliminated. There were only 7 Chinese smelters in operation during 1929, compared with 20 in 1928. Their output of metallic tin declined from more than 5,000 tons in 1928 to less than 1,000 tons in 1929. The concentrates not treated locally went almost exclusively to the two great smelting companies of the Straits Settlements.

Because of the sharp fall in the price of tin and the activities of the Tin Producers' Association those who understand the mining situation in the Federated Malay States best have ventured only the most guarded estimates of future production. The cost of producing tin concentrates is not made public by all the companies of the Federated Malay States, so it is impossible to estimate what percentage of production is unprofitable at present price levels. Upon the success or failure of the activities of the Tin Producers' Association to restrict production must depend to some extent the course of the tin-mining industry. Most of the producers have declared their willingness to follow a policy of restricted production but with reservations that have so far largely counteracted the results anticipated. The principal difficulties have been the unwillingness of companies to restrict production until convinced that all others throughout the world would do likewise, and the inability of the Tin Producers' Association to develop a plan for restricting production that would be sufficiently attractive to all. The result so far has been the declaration by many companies that their total production in 1930 will be reduced about 20 per cent from that of 1929, but such a reduction must depend on very drastic measures between now and the close of 1930.

The following quotations from the Report on the Administration of the Mines Department and on the Mining Industries for the Year 1929, Kuala Lumpur, May 9, 1930, indicate the official attitude toward production restriction on page 11:

> In the middle of November it was announced by Government that Government has recently had under consideration the matter of the rate of depletion of the potential tin resources of the Federated Malay States and has reached the conclusion after careful examination of the question that neither the industry nor the Government would derive advantage from any acceleration of the rate of depletion. It has therefore been decided that except in special cases no application for mining land or for conversion of agricultural to mining title outside existing mining areas will be considered; and further that within such mining areas alienation or conversion will not in general be approved unless it is essential for the efficient development of existing undertakings.

> This will curtail considerably the issue of prospecting licenses and was made with a view to conserving the tin resources of the Federated Malay States.

And on page 22:

> The three most noticeable features of the year were the cessation of alienation of mining land by Government, the continual drop in the price of tin, and the well sustained efforts of the Tin Producers' Association to obtain cooperation among all the tin mining countries and classes with a view to restriction of output by periodical stoppages. The Tin Producers' Association is also concerned with research and propaganda regarding new uses of tin. It is generally recognized that there can be no effective method of restriction that fails to leave the tin-ore in the ground. Stocks of the metal held off the market even under the strongest guarantees invariably act as a menace.
>
> Feeling in this country regarding these efforts to control the price to some extent weakened owing to hope of better things being deferred time after time. At the end of the year, however, the efforts of the Tin Producers' Association seemed likely to produce practical results which would be further strengthened if some reliable announcement were made regarding the elusive "invisible" supplies held or said to be held by the even more elusive "group." The complete elimination of this tin from calculations would clear the air greatly.
>
> Estimates of consumption for the coming year vary considerably and opinions can be found to suit every point of view. The general impression, however, is on the pessimistic side.
>
> No great tendency has been observed on the part of the Chinese miners to close down so far but they will in any case endeavour to carry on till the end of their financial year at the end of January, (1930).

One of the most important trends which probably will be continued in the future is that toward the consolidation of production into fewer hands. The decline of production of Chinese-owned mines and the increase of production of dredges constitute a transition from a type of producer whose output is usually small to a type of producer who, though owning but one dredge, must have a large individual output. The decision of the Government to limit further entry upon lands for mining to existing undertakings which find such lands essential to efficient development seems likely to promote the expansion of present undertakings rather than the development of small new enterprises. The concentration of production into fewer hands should make production control easier in the future.

Straits Settlements.—From the standpoint of mine production this British Crown colony has never been an important factor in the world's supply of tin ore, but in smelter production it leads the world. The needs of its large smelting industry are supplied by imports of tin concentrates from other parts of the Malay Peninsula and from the East Indies. Practically all the metallic tin produced is exported, and in consequence a record of such exports approximates the smelter production of the country. The following table shows the exports of tin from the Straits Settlements and the countries to which they were consigned.

Tin exported from British Malaya, 1927–1929, by destinations, in long tons

Destination	1927	1928	1929	Destination	1927	1928	1929
British possessions	4, 968	5, 311	4, 998	United States	46, 371	56, 984	57, 695
Countries of Europe	19, 771	19, 769	20, 622	Other countries	1, 289	1, 679	1, 272
Japan	1, 922	2, 401	2, 045				
United Kingdom	9, 452	12, 908	15, 392		83, 773	99, 052	102, 024

There are two great smelting companies operating in this colony—the Eastern Smelting Co. (Ltd.) and the Straits Trading Co. (Ltd.). The former conducts its principal operations at Penang and the latter at Pulau Brani, Singapore. The export duty on tin concentrates from the British-controlled sections of the Malay Peninsula to countries outside the British Empire affords these companies a virtual monopoly on Malayan tin smelting, and in addition to the tin concentrates from British Malaya they treat large quantities of ore imported from the Netherland East Indies, Siam, and Burma.

On December 28, 1929, Consolidated Tin Smelters (Ltd.) [12] was formed. The Eastern Smelting Co. (Ltd.) is one of its merged tin-smelting companies. Its board of directors is equally British and Bolivian. Thus the Patiño group acquired its first major interest in the tin business of the Far East.

Unfederated Malay States.—The Unfederated Malay States—Johore, Kedah, Perlis, Kelantan, and Trengganu—are distinct States governed by their several native rulers but all under the protection and control of the British Empire. These States produced tin concentrates containing 2,325 long tons of metallic tin in 1929, compared with 2,689 tons in 1928 and 2,047 tons in 1927. Johore and Trengganu are the principal producers, but each of the other States makes some contribution to the total tin output.

BOLIVIA

In 1929 Bolivia continued to be the world's second largest producer and exporter of tin and the leading producer of lode tin. The production of tin in 1929 was 46,343 long tons, an increase of 4,934 tons over the production of 41,409 tons in 1928 and an increase of 10,535 tons over the production of 35,808 tons in 1927. The production in 1929 showed an increase of 54 per cent over that in 1926, the highest 4-year percentage increase among the principal tin-producing countries. The product from the mines, concentrates containing about 60 per cent of tin and known in the trade by the native name "barilla," was all exported for treatment abroad. Most of it went to the United Kingdom, and smaller amounts went to Germany, Belgium, the Netherlands, France, and the United States. The following tables show the exports of tin in concentrates from Bolivia in 1928 and 1929, by months, and the yearly exports, 1927, 1928, and 1929, by destinations.

Tin contained in concentrates exported from Bolivia, 1928 and 1929, by months, and average grade of concentrates exported [a]

Month	1928		1929		Month	1928		1929	
	Long tons	Grade of concentrates (per cent of tin)	Long tons	Grade of concentrates (per cent of tin)		Long tons	Grade of concentrates (per cent of tin)	Long tons	Grade of concentrates (per cent of tin)
January	3, 594	55. 89	3, 692	56. 14	August	3, 410	55. 79	3, 471	55. 51
February	2, 534	53. 14	3, 079	55. 81	September	3, 645	54. 60	3, 676	54. 42
March	3, 368	53. 06	4, 129	54. 80	October	3, 335	54. 31	4, 172	54. 86
April	3, 518	54. 56	4, 350	56. 05	November	3, 767	55. 34	3, 418	54. 19
May	3, 672	56. 37	3, 959	54. 21	December	3, 707	55. 35	4, 290	55. 68
June	3, 173	55. 02	3, 832	55. 89					
July	3, 687	56. 22	4, 269	55. 70		41, 410	55. 02	46, 337	55. 27

[a] Compiled from monthly figures furnished by U. S Bureau of Foreign and Domestic Commerce. Slight adjustments were made at the end of each year. For adjusted totals see world table on p. 349.

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[12] Mining Journal (London), vol. 168, No. 4924, Jan. 4, 1930, p. 9.

Tin concentrates exported from Bolivia, 1927–1929, by countries [1]

Country	1927			1928			1929		
	Concentrates (long tons)	Tin content		Concentrates (long tons)	Tin content		Concentrates (long tons)	Tin content	
		Long tons	Per cent		Long tons	Per cent		Long tons	Per cent
United Kingdom	61,952	34,040	54.94	71,280	39,844	55.90	78,710	44,994	57.16
Belgium	43	17	39.53	1,458	378	25.95	3,623	863	23.83
Germany	3,190	1,736	54.42	2,186	1,046	47.86	961	260	27.01
Netherlands				262	102	38.71	512	205	40.13
France				45	16	35.61	27	13	46.44
United States	194	90	46.39	35	24	69.31	6	2	33.92
Australia	30	18	59.68						
Chile	55	16	29.09						
	65,464	35,917	54.87	75,266	41,410	55.02	83,839	46,337	55.27

[1] Compiled from monthly figures furnished by U. S. Bureau of Foreign and Domestic Commerce. Slight adjustments were made at the end of each year. For adjusted totals see world table on p. 349.

A large part of the Bolivian tin concentrates exported to the United Kingdom is smelted and refined by Williams, Harvey & Co. (Ltd.) of Liverpool and marketed under the firm's brand "Mellanear Tin." This company treats the entire output of Patiño Mines & Enterprises Consolidated (Inc.), the largest tin-producing company in the world.

The Patiño Mines & Enterprises Consolidated (Inc.), a company incorporated under the laws of Delaware, is the result of a consolidation of many of Simon I. Patiño's tin-mining and allied interests in Bolivia. The company's properties are in the vicinity of Llallagua, Province of Bustillo, Department of Potosí. The production from its mines accounted for 49 per cent of the tin content in the concentrates exported from Bolivia.[13] The following table has been compiled from data contained in Beard's article.

Mining and milling results of the Patiño Mines & Enterprises Consolidated (Inc.), 1925–1929

Year	Ore milled			Barilla produced		Cost per pound of tin (including marketing barilla)
	Metric tons	Grade (per cent of tin)	Recovery (per cent)	Long tons	Tin content (per cent)	
1925	144,580	6.65	79.88	10,032	(1)	(1)
1926	232,775	5.67	69.20	9,697	62.16	$0.344
1927	299,858	4.97	75.88	12,156	64.69	.323
1928	481,028	4.64	77.39	17,289	64.32	.288
1929	703,592	3.94	76.69	20,926	63.98	.292

[1] Not given.

The so-called Patiño group greatly increased its importance in the world's tin-producing industry during 1929. The following is quoted: [14]

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[13] Beard, R. R., Property and Operation of Patiño Mines and Enterprises at Llallagua, Bolivia: Eng. and Min. Jour., vol. 130, No. 3, Aug. 9, 1930, pp. 107–109; concluded in the two subsequent issues.

[14] Mining Journal (London), Patiño Mining and Smelting Interests: Vol. 168, No. 4927, Jan. 25, 1930, pp. 41–44.

In the year of record tin output which has been further marked by such unprecedented changes and consolidations in the industry, as 1929 the great Patiño group of enterprises could not remain unaffected. Nowhere perhaps has effective consolidation been more active, and with this has come more general appreciation of the leading part which this group is coming to play in the future of the industry. The big smelter fusion alone recently consummated is an outstanding achievement of the year and it leaves Patiño interests not merely predominant in the control of tin smelting in Europe, but through the Eastern Smelting Co., affords a substantial entry into this branch of business in the Far East also.

Sr. Patiño is best known through his control of the Patiño Mines & Enterprises, Consolidated, which, by the buying out of the National Lead interests recently, controls the whole of the Williams, Harvey works at Liverpool—next to the Straits Trading Co. the largest tin smelter in the world. But this does not represent all Sr. Patiño's interests. He has a controlling interest in other leading Bolivian properties, more particularly Uyuni, Araca and more recently Oploca, so that altogether he is believed to-day to control some 40,000 tons of concentrates, or approximately two-thirds of the Bolivian output. Nor is this all. With his unique knowledge of the country, active mind and great resources he has carried on the development of various prospects which to-day could probably, should it become necessary, be revealed as coming mines. His constant study of the tin industry has also led him to take substantial interests in various of the best managed properties in Malaya. * * *

For the present, at any rate, it is in connexion with the Patiño Mines & Enterprises Consolidated, that Sr. Patiño's name is generally associated as the President of the biggest tin producing company in the world, and as such it claims first and chief attention.

* * * * * * *

The Patiño organization is, of course, a vertical combine which, through the possession of so large an output from its own mines finds the great bulk of the material necessary to the operation of its smelter in Liverpool. Speaking in round figures, the Bottle smelter treated last year about 60,000 tons of concentrates, of which about 40,000 tons were contributed by the various Bolivian mines under the Patiño control, about 5,000 tons from Nigeria and the balance from other sources, chiefly Bolivian. The production of metallic tin from this supply of concentrates will be slightly in excess of 36,000 tons. * * *

In the smelting merger announced at the meeting of the Eastern Smelting Company shortly before Christmas further consolidation was effected. As is well known, Williams, Harvey & Company, the Eastern Smelting Company, the Cornish Tin Smelting Company and the Penpoll Tin Smelting Company, representing collectively a total output of probably something like 77,000 to 78,000 tons of tin last year, became merged in the Consolidated Tin Smelters, Limited, with a nominal capital of £5,000,000, and an issued capital of £4,000,000. In a board consisting of 10 members the Patiño group holds 5 seats with Senor Patiño as President. * * *

The Consolidated Tin Smelters, Limited, thus becomes the largest producer of tin in the world today, and if we add to the total already given that of the Straits Trading Company, we get a total of just about 140,000 tons of tin, out of the world's production of, say, 190,000 tons, centered in two big organizations. * * *

It is reported that many of the smaller tin-mining companies are being closed down by the fall in the tin price. So important, however, is the production of tin in the national economy of Bolivia that the government will undoubtedly do everything in its power to relieve taxation and promote the industry.

NETHERLAND EAST INDIES

The principal tin-producing areas of the Netherland East Indies are on the small islands of Banka, Billiton, and Singkep. This chain of islands is geologically a continuation of the range of mountains that forms the backbone of the Malay Peninsula and along the sides of which the tin deposits of the peninsula occur.

The production of tin in the Netherland East Indies was 30,586 long tons in 1929, compared with 35,660 tons in 1928 and 34,487 tons in 1927.

The following table gives the production of the Netherland East Indies from 1925 to 1929.

Tin content of tin ores produced in the Netherland East Indies, 1925–1929, in long tons

District	Operator	1925	1926	1927	1928	1929
Banka [1]	Government	20,469	19,851	21,535	21,483	16,604
Billiton [1]	Billiton Co	9,557	11,322	11,869	12,981	12,609
Singkep Island [1]	Singkep Tin Co	668	1,000	955	990	1,074
Singkep Sea dredging [1]						
Sumatra	Stannum Co	3	61	128	173	217
Riouw Archipelago					33	82
		30,697	32,234	34,487	35,660	30,586

[1] Figures are for various fiscal years, as follows: Banka, Mar. 1 to Feb. 28; Billiton, June 1 to May 31; Singkep, July 1 to June 30.

There are, and have been for many years, but three large operators in the Netherland East Indies—the Dutch Government, the Billiton Co., and the Singkep Tin Co.

The government areas are on the Island of Banka and supply approximately 60 per cent of the total production of the country. The tin is mined largely from alluvial deposits worked by open-pit methods, but dredges are now being introduced. Most of the work is done by Chinese coolies either under contract or under the direct supervision of government agents.

The Billiton Co. has held a tin-mining concession on the Island of Billiton since 1852 and is the only important producer on the island. The company obtains the larger part of its production from alluvial deposits. Unlike the government areas of Banka, however, there is an important production from tin-bearing lodes on Billiton. The company pays the government a royalty of five-eighths of the profits made in alluvial mining.

The Singkep Tin Co. operates under a concession granted in 1899. This company operates alluvial and lode mines on Singkep Island and in addition recovers some tin by dredging the sea bottom near the island.

The tin concentrates of the Netherland East Indies are smelted partly within the country and partly in the Straits Settlements.

A new smelter at Arnhem, in the Netherlands, blown in during June, 1929, may divert some of the concentrates to Europe. It was built primarily to treat Bolivian concentrates by a smelting company that was financed principally by the Billiton Co., which is acting as its marketing agent.

The attitude of the Government of the Netherland East Indies toward production restriction is brought out in its statement: [15]

> The government of the Dutch East Indies issued the following statement in Batavia on March 8:
>
> Equilibrium in the tin markets has been disturbed mainly by the large increase of tin production in Bolivia and Malacca, as the result of which prices have fallen

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[15] American Metal Market, Banka Tin Production Will Not Exceed 22,000 Tons: Vol. 37, No. 61, Mar. 28, 1930, p. 4.

to a level which, if maintained longer, must inevitably lead to the cessation of so large a part of the present production as to enable consumption to exceed production and again to cause an increase of prices.

The government considers that such violent price fluctuations cause serious detriment to producers as well as to consumers. It is therefore in favor of every effort being made to reach a stabilization of the price of tin on such a level as will satisfy consumers that the necessary production is being maintained while at the same time preventing the artificial forcing up of prices.

The Government, in view of the present very low price level, has decided not to increase the production in Banka Island, where the maximum for 1930 is fixed for 22,000 tons.

NIGERIA

Nigeria exported tin concentrates containing 10,742 long tons of tin in 1929, compared with 9,132 tons in 1928 and 8,056 tons in 1927. Most of the production was derived from the alluvial deposits of the Bauchi Plateau in the northeastern part of the country, several hundred miles from the Atlantic coast.

The British Colony and Protectorate of Nigeria is undergoing rapid development, which is taking the form of road and city building and provision of electric power. Railroads and motor transports are being substituted for carriers, pack animals, and river barges. As the tin fields lie more than 500 miles from ocean shipping points the development of competing transportation systems is of great importance to the tin-mining industry. The expansion in production which continued through 1929 apparently has been checked by falling prices. In addition, the government has suspended certain regulations which were originally designed to force development and increase production.

From the standpoint of world production the companies of Nigeria are for the most part very small. The one outstanding producer of tin concentrates is the Associated Tin Co., a subsidiary of the Anglo-Oriental Mining Corporation (Ltd.). This organization, in consolidating smaller companies, has brought under its control the mines that furnish the bulk of its present production, but it has also been active in developing properties on its own account. Added to these operations has been its development of central power stations to serve the mining industry of Nigeria.

Improved transportation, mining methods, and power facilities apparently have greatly reduced costs in this region. Most of the companies have announced their intention to carry out the restrictive measures of the Tin Producers' Association, but have not ceased production at prices that a year ago they claimed would be prohibitive.

SIAM

Siam continued to produce at about the same rate as in 1928 and 1927. The output was approximately 8,000 long tons in 1929, compared with 7,800 tons in 1928 and 7,813 tons in 1927. The tin deposits are in the part of Siam that occupies a portion of the Malay Peninsula; they are found on both sides of the mountain range that forms the backbone of the peninsula. At present the most productive areas are on the western side of the range and include among others the Puket Island and Tongkah Harbor districts. It is interesting to note that the proportion produced by dredging operations has increased at the same time that the price of tin has fallen. Except for concentrates treated by a few native smelters supplying local markets, all the concentrates are shipped to the great smelting centers of the Straits Settlements for treatment.

CHINA

The shipments from China in 1929 are reported as 6,500 long tons of tin, compared with 7,033 tons in 1928 and 6,220 tons in 1927. The unsettled political condition of the country since the nationalist revolt and the accompanying banditry seem to have had little effect upon the shipments. The bulk of the production comes from the area extending from the Kotchiu district near Mengtze in the southeastern part of Yunnan into the adjacent Provinces of Kwantung and Kwangsi and into northern French Indo-China. The production was originally attributed to alluvial deposits, but closer examination has shown that the tin occurs in well-defined veins in a country rock of limestone and granite. Originally the deeply oxidized outcrops were worked as alluvial deposits; at present the deeper mines have a vertical depth of more than 1,000 feet. The work is carried on by rather primitive methods, and the output is limited to a great extent by the inadequacy of the supply of water for concentration. The output is smelted in native furnaces using charcoal.

UNITED KINGDOM

The production of tin (content of domestic ores) in the United Kingdom was 3,271 long tons in 1929, compared with 2,761 tons in 1928 and 2,593 tons in 1927. Virtually the entire output came from Cornwall, a century ago the leading tin-producing region of the world. The production comes largely from mines with long histories, some dating back to the Roman period. The revival of mining in this region, begun during the period of high tin price, has continued to increase production, but the outlook for future increases apparently is not favorable, as much of the production at present is from high-cost mines already made unprofitable by the recent price decline. It is reported that the alluvial mines have fared better than the lode mines at the lower price level.

The importance of the United Kingdom in tin production is not based upon the ore output of the mines of Cornwall, but rather upon the tin output of the smelters of Liverpool in Lancaster and Redruth in Cornwall. The combined capacity of these smelting plants is approximately 72,000 tons of tin per year, or 40 per cent of the world's annual smelter output. The formation of Consolidated Tin Smelters (Ltd.) places virtually all the tin smelting in the United Kingdom under one management. This should effect important economies as well as strengthen the British position in the tin-smelting business. Tin smelting in the British Isles is made profitable largely because that country is the natural meeting point of cheap fuel, expert smeltermen, Bolivian concentrates, and Nigerian concentrates. Mixing the two types of concentrates effects smelting economies by diluting the impurities present in the Bolivian product. The consolidation of the smelter of the Patiño group (Williams, Harvey), which controls much of the Bolivian output, with the smelter of the Anglo-Oriental group (Penpoll), which controls much of the Nigerian output, should make possible the most efficient mixed smelter charges. The Penpoll smelter has been closed temporarily as a result of the consolidation and because of lower demand.

The shifts in nationality of the controlling groups have been interesting. The following statement[16] by E. J. Cornish, president of the National Lead Co., was made after the exit of American influence from the British tin-smelting industry:

> National Lead Company has sold its one-half interest in Williams, Harvey & Company, Ltd., of Liverpool, England, to the Patiño Mines & Enterprises Consolidated, Inc., subject to the approval of the transaction by the stockholders of the latter company at a special meeting being called for the purpose.
>
> Unfortunately, the interests of National Lead as a consumer and also as a smelter conflict with the interests of the mines. Inasmuch as Señor Simon I. Patiño, president of the Patiño Mines & Enterprises Consolidated, Inc., contributes directly or through his personal influence over three-fourths of the ore smelted by Williams, Harvey & Company, Ltd., we could not do otherwise than conform to his request to part with the property on an equitable basis.
>
> National Lead owns approximately 69,000 shares (issued capital 1,380,316 shares) of stock in Patiño Mines & Enterprises Consolidated, Inc., and I hope at some time may recover its standing in the tin-smelting world by the ownership of a much larger number of shares in Patiño Mines & Enterprises Consolidated, Inc.

This change gave control of Williams, Harvey & Co. (Ltd.) to Bolivian capital. There followed the formation of Consolidated Tin Smelters (Ltd.) which amalgamated the interests of Williams-Harvey, Penpoll, Redruth, and Eastern. On the board of this company are 10 directors of whom five belong to the Patiño group and the remainder belong to various English groups. It may be said, therefore, that financial control of all the tin smelting in the United Kingdom is equally divided between Great Britian and Bolivia.

OTHER COUNTRIES

The countries separately discussed accounted for an output of about 175,000 long tons of tin, or 95 per cent of the 1929 world total. Australia, India, and the Union of South Africa supplied more than half of the remaining 10,000 tons.

Tin production in Australia showed a marked decline, from 2,890 long tons in 1928 to 2,239 tons in 1929. Of particular interest was the shutdown of the mines and smelter of the Mount Bischoff Tin Mining Co. of Tasmania. This company had been the leading tin producer of Australia for many years and had operated without a break since 1873. The curtailment of Australian tin output, apparently, is less the result of exhaustion of ore than of the relatively high cost of production.

The tin output of the British Indian Province of Burma is derived largely from alluvial deposits near Tavoy, a seacoast town in southern Burma. These deposits are a northern continuation of the Malay Peninsula tin-bearing region.

In addition to Nigeria, Africa has several minor tin-producing districts and several areas which give promise of future production. The Union of South Africa and the Belgian Congo are now the chief of such districts. Much prospecting for and some development of tin deposits is being carried on in Tanganyika, Uganda, South-West Africa, Swaziland, Gold Coast, French Morocco, Portuguese East Africa, and Rhodesia. The prospecting and development campaign of the Billiton Co. in the countries of Central Africa has been of large scope and may produce results of more than local importance in the near future.

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[16] Engineering and Mining Journal, Patiño Mines Acquires Complete Control over Williams, Harvey Smelter: Vol. 128, No. 3, July 20, 1929, p. 115.

Among the other countries producing small amounts of tin in 1929 or developing tin deposits are Portugal, Spain, Japan, Indo-China, Canada, Mexico, Russia, Germany, Czechoslovakia, Argentina, and France.

WORLD'S TIN SMELTERS

Name, location, control, and capacity of the world's tin smelters in 1929

Smelter	Location	Control	Capacity (long tons) [1]
Straits Trading Co. (Ltd.)	Singapore and Butterworth, Straits Settlements.	British	65,000
Williams, Harvey & Co. (Ltd.)	Liverpool, England	British-Bolivian [2]	45,000
Eastern Smelting Co. (Ltd.)	Penang, Straits Settlements		25,000
Cornish Tin Smelting Co. (Ltd.)	Redruth, Cornwall		15,000
Penpoll Tin Smelting Co. (Ltd.)	Liverpool, England		12,000
	Netherland East Indies	Dutch	25,000
Arnhem	Arnhem, Netherlands	do	[3] 1,500
		German and others	8,000

[1] Annual production of pig tin as reported in Mining Magazine (London), vol. 39, August, 1928, p. 86.

[2] Control the result of formation of Consolidated Tin Smelters (Ltd.), which is equally controlled by British and Bolivian interests.

[3] Approximate tin content of ores purchased during 1929.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN IDAHO[1]

(MINE REPORT)

By C. N. GERRY and T. H. MILLER[2]

SUMMARY

The value of the mine production of gold, silver, copper, lead, and zinc in Idaho increased from $26,667,706 in 1928 to $31,104,246 in 1929, and the quantity of all these metals except gold increased materially. The output of zinc was the largest that has ever been recorded in the State, and the output of lead and silver was also especially large. The increase in the output of copper was due chiefly to the advance in the average price of the metal from 14.4 cents a pound in 1928 to 17.6 cents a pound in 1929. The total value of the metal output of Idaho in 1929 was decidedly more than the average annual value for the decade 1920 to 1929, which was $26,604,749. Since 1863 Idaho's output of the five metals has been as follows: Gold, $137,066,890; silver, 317,027,379 fine ounces; copper, 154,261,119 pounds; lead, 8,799,701,286 pounds; and zinc, 769,028,479 pounds. The total value has amounted to $938,507,166, more than half of which represents the value of the lead. The value of the metal output of Idaho from the early days of mining is by no means as large as that of Arizona, California, Colorado, Montana, or Utah, but in 1929 Idaho was third in silver output after Utah and Montana and third in lead output after Missouri and Utah. Dividends for 1929, taken largely from the annual printed reports of the companies but partly estimated, amounted to about $5,000,000. It is impossible to name the exact total, as part of the dividend disbursement is paid from operations in other States, and the amount paid by certain lessees is not reported.

Although the metal output of Idaho in 1929 was derived from 23 counties, most of the silver, lead, and zinc was recovered from ore and concentrates from Shoshone County (the famous Coeur d'Alene region), whose metal output was valued at $28,439,351, an increase of $3,646,906 over that of 1928. Custer, Blaine, Butte, Boise, and Lemhi Counties followed in order, but only two (Custer and Blaine) attained an output valued at more than $500,000 in 1929.

Tables printed in Mineral Resources for 1922 and subsequent years give the source of the different metals by kinds of ore and by years

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[1] Work on manuscript completed January, 1931.

[2] The valuable assistance of Paul Luff, of the Bureau of Mines, is acknowledged.

from 1911 to 1928. During the decade 1920 to 1929, 83 per cent of the gold was derived from placers and from dry and siliceous ore; 68 per cent of the silver and more than 75 per cent of the lead came from lead ore; and most of the remainder of the silver and lead came from lead-zinc ore and zinc ore. Since 1927 a large quantity of silver and lead has come from copper-lead ore. In 1929 nearly 84 per cent of the gold was derived from placers and from dry gold ore and most of the remainder came from copper ore; 50 per cent of the silver and 60 per cent of the lead came from lead ore; nearly all the remainder of the lead came from lead-zinc ore; and nearly all the remainder of the silver came from lead-zinc ore and copper-lead ore.

The report[3] of the mine inspector of Idaho contains notes on the progress of the mining industry, lists the active producing and developing companies by counties, includes accident statistics, and gives an interesting bibliography for each county. The inspector estimates that 6,000 men were employed in Idaho mines in 1929.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price from 1920 to 1922 is New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1920	$1.09	$0.184	$0.080	$0.081	1925	$0.694	$0.142	$0.087	$0.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064
1923	.82	.147	.070	.068	1928	.585	.144	.058	.061
1924	.67	.131	.080	.065	1929	.533	.176	.063	.066

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1920–1929, in terms of recovered metals

Year	Mines producing		Ore, old tailings, etc. (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1920	114	49	1,958,401	23,490.42	$485,590	7,326,794	$7,986,205
1921	133	92	1,514,447	26,399.73	545,731	6,080,528	6,080,528
1922	154	94	1,436,884	24,255.46	501,405	6,081,865	6,081,865
1923	146	85	1,763,520	37,124.28	767,427	7,673,662	6,292,403
1924	141	79	1,711,988	26,921.80	556,523	7,793,154	5,221,413
1925	190	85	1,827,715	20,886.92	431,771	7,743,439	5,373,947
1926	177	69	1,934,143	13,669.27	282,569	7,556,444	4,715,221
1927	148	70	2,018,325	15,315.67	316,603	8,901,409	5,047,099
1928	151	56	2,054,329	20,980.38	433,703	8,998,330	5,264,023
1929	147	51	2,174,125	20,247.11	418,545	9,414,403	5,017,877

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[3] Campbell, Stewart, Thirty-first Annual Report of the Mining Industry of Idaho, for 1929.

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1920–1929, in terms of recovered metals—Continued

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1920	2, 538, 396	$467, 065	249, 609, 976	$19, 968, 798	27, 932, 326	$2, 262, 518	$31, 170, 176
1921	1, 688, 195	217, 777	198, 469, 119	8, 931, 110	33, 463	1, 673	15, 776, 819
1922	3, 282, 842	443, 184	195, 834, 205	10, 770, 881	4, 109, 131	234, 220	18, 031, 555
1923	3, 979, 631	585, 006	242, 355, 733	16, 964, 901	27, 952, 749	1, 900, 787	26, 510, 524
1924	2, 738, 824	358, 786	248, 950, 292	19, 916, 023	15, 340, 498	997, 132	27, 049, 877
1925	3, 297, 443	468, 237	253, 041, 790	22, 014, 636	31, 237, 240	2, 374, 030	30, 662, 621
1926	1, 337, 442	187, 242	272, 980, 212	21, 838, 417	52, 614, 691	3, 946, 102	30, 969, 551
1927	2, 173, 163	284, 684	302, 038, 423	19, 028, 421	53, 556, 345	3, 427, 606	28, 104, 413
1928	2, 072, 165	298, 392	290, 645, 905	16, 857, 462	62, 526, 648	3, 814, 126	26, 667, 706
1929	5, 131, 438	903, 133	297, 389, 488	18, 735, 538	91, 350, 807	6, 029, 153	31, 104, 246

Gold and silver produced at placer mines in Idaho, 1920–1929

Year	Gold		Silver		Year	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value		Fine ounces	Value	Fine ounces	Value
1920	5, 505. 76	$113, 814	1, 119	$1, 219	1925	12, 692. 92	$262, 386	2, 812	$1, 952
1921	8, 784. 90	181, 600	1, 686	1, 686	1926	8, 360. 45	172, 826	2, 029	1, 266
1922	8, 899. 64	183, 972	1, 959	1, 959	1927	7, 520. 33	155, 459	2, 306	1, 308
1923	24, 125. 05	498, 709	6, 616	5, 425	1928	8, 191. 63	169, 336	2, 538	1, 485
1924	17, 324. 10	358, 121	4, 248	2, 846	1929	4, 129. 92	85, 373	1, 419	756

GOLD

The production of gold in Idaho in 1929 was $418,545, a decrease of 3.5 per cent from that of 1928 and an output considerably less than the average annual output ($473,987) for the decade 1920 to 1929. The decrease was due chiefly to the inactivity of the dredge of the South Park Dredging Co. at Featherville, Elmore County. This company ranked first as a producer of gold in Idaho in 1927 and second in 1928. There was also a substantial decrease in the production of gold from the Idawa property, a famous producer in Boise County, but this decrease was offset by the increased production of gold from the Gold Hill & Iowa mine, an exceptionally large producer from 1911 to 1924. In 1929 gold from lode mines increased, especially that from the Gold Hill & Iowa mine, but gold from placer mines was only half that of 1928. More than 47 per cent of the State's output of gold in 1929 was produced from the Idawa and Gold Hill & Iowa properties. Lode mines yielded $333,172 in gold in 1929, an increase of 26 per cent over 1928, and placers yielded $85,373. Of the placer output $60,143 was won by dredges, a decrease of $73,275 from the dredge output in 1928. Since 1897 gold worth $6,087,075 has been recovered by dredges. Gold from copper ore as well as that from gold ore increased decidedly in 1929, but a decrease was recorded from lead ore. The production of gold from mills using amalgamation was 11,634.13 ounces, 57 per cent of the total gold output in 1929 and an increase from 8,459.24 ounces in 1928. Concentrates of all kinds yielded nearly 16 per cent of the total gold, crude ore shipped for smelting yielded 6 per cent, and placers yielded 20 per cent.

In 1929 five mines had a gold output of more than $23,000 each—those of the Idawa Gold Mining Co., at Placerville; the Talache Mines (Inc.) (Gold Hill & Iowa mine), at Quartzburg; the Mackay Metals (Inc.), at White Knob; the Idaho Gold Dredging Corporation, at Centerville; and the Unity Gold Mines Co., at Warren. Other large producers of gold were the American Gold Dredging Corporation, at Triangle; the Lone Pine mine, at Golden; and the Boise Placer Co., at Idaho City. Dredging operations in Owyhee County and the resumption of mining and milling at the Gold Hill & Iowa mine prevented a much larger decrease in the gold output from Idaho in 1929.

SILVER

The production of silver in Idaho in 1929 was 9,414,403 ounces, the largest output since 1917, when 12,029,338 ounces was produced; it was decidedly more than the yearly average for the decade 1920 to 1929, which was about 7,757,000 ounces. Compared with other large producing States Idaho produced more silver than Arizona or Nevada but less than Utah or Montana. The output of silver in Shoshone County increased 263,678 ounces, and there were also good increases in Custer, Blaine, Butte, and Valley Counties, but the output from Lemhi, Boundary, and Boise Counties was much smaller. The increase in silver was due chiefly to the decided increase in shipments of copper-lead concentrates rich in silver from the Sunshine mine in Shoshone County; the Golconda, Star, Livingston, Dayrock, Sherman, Crescent, Triumph, and Page mines also made good increases in silver output. The Morning mine, the largest producer of silver in Idaho in 1925, 1926, and 1927, decreased its output considerably in 1929.

Concentrates yielded nearly 92 per cent of the total silver, crude smelting ore more than 8 per cent, and placer bullion and gold and and silver bullion from lode mines less than one-tenth of 1 per cent.

The Bunker Hill & Sullivan property was the largest producer of silver, followed by the Sunshine, Hecla, and Morning mines; each of these properties yielded more than 1,300,000 ounces of silver. These four properties produced nearly 70 per cent of the State's output of silver. Other large producers of silver were the Crescent, Dayrock, Gold Hunter, Tamarack & Custer, Golconda, Page, Sherman, Triumph, and Livingston mines. The spectacular feature of 1929 in silver production was the advance of the Sunshine mine from fourth to second place, passing the Morning and Hecla mines which ranked second and third in 1928.

COPPER

The production of copper in Idaho in 1929 was 5,131,438 pounds, the largest output since 1918, when 6,533,888 pounds was produced. The output in 1929 was nearly double that of the average yearly output (about 2,823,950 pounds) for the decade 1920 to 1929. The increase was due to the advance in the average price of copper from 14.4 cents a pound in 1928 to 17.6 cents a pound in 1929. The production of copper in Custer County increased from 532,400 pounds in 1928 to 2,837,398 pounds in 1929 as a result of the increased output of the Mackay Metals (Inc.). Good increases in copper were also recorded in Lemhi and Shoshone Counties. The Winder-Stillman Consolidated and the Harmony Mines Co., both operating mines in Lemhi County, increased their output of copper considerably. Concentrates of all kinds yielded 76 per cent of the total copper and crude smelting ore 24 per cent. The largest producers of copper in in the State in 1929 were the Mackay Metals (Inc.), near Mackay, Custer County; the Winder-Stillman Consolidated (Pope-Shenon mine), near Salmon, Lemhi County; the Sunshine and Hecla mines, in Shoshone County; the Harmony mine, in Lemhi County; and the Tamarack & Custer and Morning mines, in Shoshone County.

LEAD

The production of lead in Idaho in 1929 increased more than 2 per cent in quantity over 1928, and was much more than the average annual output (255,131,514 pounds) for the decade 1920 to 1929. The gain was due chiefly to the great increase in the output of lead from the Star and Golconda mines, which offset the large decreases from the Tamarack & Custer, Morning, Bunker Hill & Sullivan, and Galena mines. The output of lead from the Gold Hunter, Hayes, and United Idaho properties decreased considerably, but that from the Sherman, Livingston, Jack Waite, Wilbert, Page, Sidney, and Dayrock mines increased. Shoshone County supplied 95 per cent of the total lead, and Custer, Butte, Blaine, and Bonner Counties also made good production. Concentrates of all kinds yielded 92 per cent of the total lead and crude smelting ore 8 per cent.

Fourteen mines produced more than 3,700,000 pounds of lead each in 1929. Three of them—the Bunker Hill & Sullivan, Morning, and Hecla—yielded more than 56,000,000 pounds each; together they produced nearly 69 per cent of the State's output of lead. The other large producers were the Page, Tamarack & Custer, Star, Sherman, Gold Hunter, Golconda, Dayrock, Livingston, Jack Waite, Sidney, and Wilbert mines. All these properties are in Shoshone County except the Livingston mine, near Mackay, Custer County, and the Wilbert mine, near Howe, Butte County.

ZINC

The production of zinc in Idaho in 1929 amounted to 91,350,807 pounds, the largest output that has ever been recorded in the State and an increase of 46 per cent over that of 1928; it was also 4,845,588 pounds more than the former record output (86,505,219 pounds) of 1916. The gain was due chiefly to the great increase in lead-zinc ore mined at the Star, Golconda, Sidney, Constitution, and Triumph mines and to the increase in the output of zinc from the Morning mine of the Federal Mining & Smelting Co. The Morning mine produced nearly 40 per cent of the State's output of zinc and increased its production more than 15 per cent over that of 1928. All the zinc concentrates, except those from Blaine, Bonner, and Valley Counties, came from the Coeur d'Alene region, where the largest producers of zinc were the Morning, Star, Sidney, Tamarack & Custer, Golconda, Frisco, Bunker Hill & Sullivan, Constitution, Page, and Hecla mines. The Triumph mine, near Hailey, Blaine County, ranked sixth as a producer of zinc in Idaho in 1929; considerable zinc was also produced from old tailings deposited in Canyon Creek, near Wallace. Ore that was not milled locally was shipped to custom milling plants at Butte and Anaconda, Mont., and Bauer and Midvale, Utah. The resulting zinc products were treated at the electrolytic zinc plants at Anaconda and Great Falls, Mont., and at the new electrolytic plant of the Sullivan Mining Co. at Silver King, Idaho.

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1929, by counties, in terms of recovered metals

County	Gold					Silver (lode and placer)	
	Lode		Placer		Total value		
	Fine ounces	Value	Fine ounces	Value		Fine ounces	Value
Ada	22.59	$467			$467	9	$5
Adams	5.32	110			110	311	166
Bear Lake						203	108
Blaine	201.77	4,171			4,171	181,968	96,989
Boise	9,997.57	206,668	2,568.03	$53,086	259,754	9,520	5,074
Bonner	5.56	115			115	90,805	48,399
Bonneville			9.72	201	201		
Boundary						83	44
Butte	3.53	73			73	56,375	30,048
Camas	40.49	837			837	168	90
Clark						48	26
Clearwater			50.50	1,044	1,044	10	5
Custer	2,479.94	51,265	55.10	1,139	52,404	246,579	131,427
Elmore	24.86	514	13.84	286	800	21	11
Gem	59.65	1,233			1,233	581	310
Idaho	2,034.65	42,060	234.72	4,852	46,912	3,259	1,737
Latah	1.02	21	6.24	129	150	36	19
Lemhi	284.93	5,890	169.41	3,502	9,392	16,496	8,792
Owyhee	269.98	5,581	946.60	19,568	25,149	8,208	4,375
Shoshone	472.43	9,766	38.22	790	10,556	8,776,726	4,677,995
Twin Falls			20.22	418	418	2	1
Valley	211.25	4,367	17.32	358	4,725	17,783	9,478
Washington	1.65	34			34	5,212	2,778
	16,117.19	333,172	4,129.92	85,373	418,545	9,414,403	5,017,877
Total, 1928	12,788.75	264,367	8,191.63	169,336	433,703	8,998,330	5,264,023

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Ada							$472
Adams	26,512	$4,666					4,942
Bear Lake			126,514	$7,970			8,078
Blaine	3,942	694	3,072,971	193,597	4,983,727	$328,926	624,377
Boise	958	169	4,182	264			265,261
Bonner	993	175	1,727,491	108,832	2,718	179	157,700
Bonneville							201
Boundary	122	21	7,297	460			525
Butte	46	8	3,751,144	236,322			266,451
Camas	323	57	3,330	210			1,194
Clark			9,164	577			603
Clearwater							1,049
Custer	2,837,398	499,382	4,679,135	294,786			977,999
Elmore							811
Gem	90	16	4,130	260			1,819
Idaho	75	13	584	37			48,699
Latah	8,270	1,456					1,625
Lemhi	914,819	161,008	695,640	43,825			223,017
Owyhee							29,524
Shoshone	1,320,700	232,443	283,115,336	17,836,266	86,092,294	5,682,091	28,439,351
Twin Falls							419
Valley	9,366	1,648	156,459	9,857	272,068	17,957	43,665
Washington	7,824	1,377	36,111	2,275			6,464
	5,131,438	903,133	297,389,488	18,735,538	91,350,807	6,029,153	31,104,246
Total, 1928	2,072,165	298,392	290,645,905	16,857,462	62,526,648	3,814,126	26,667,706

Ore, old tailings, etc., sold or treated, lode mines producing, and average value of ore, etc., in gold and silver in Idaho, 1928 and 1929, by counties

County	Ore, old tailings, etc. (short tons)		Lode mines producing		Average value per ton in gold and silver	
	1928	1929	1928	1929	1928	1929
Ada	5	13	3	2	$56.40	$36.31
Adams	22	42	1	1	6.36	6.57
Bear Lake	21	89	1	1	1.76	1.21
Blaine	18,478	26,838	16	20	4.92	3.77
Boise	6,440	21,782	10	8	31.39	9.70
Bonner	2,546	11,945	5	7	17.76	4.06
Boundary	6,335	16	2	1	1.83	2.75
Butte	11,324	14,412	6	2	1.72	2.09
Camas	41	56	1	2	18.02	16.55
Clark		13		1		2.00
Custer	42,478	92,405	13	11	1.92	1.98
Elmore	21	17	2	4	12.90	30.76
Gem	1,639	300	1	2	5.00	5.14
Idaho	1,671	2,898	8	6	16.78	15.11
Latah		44		1		.89
Lemhi	12,480	27,551	24	21	3.54	.53
Owyhee	311	202	12	9	14.21	48.00
Shoshone	1,949,980	1,971,580	42	44	2.56	2.38
Valley	516	3,729	3	2	4.36	3.71
Washington	21	193	1	2	2.33	14.57
	2,054,329	2,174,125	151	147	2.69	2.46

Gold and silver produced at placer mines in Idaho in 1929, by counties

County	Mines			Gold	Silver (fine ounces)	Total value
	Drift	Dredge	Hydraulic and sluicing			
Boise		2	8	$53,086	834	$53,530
Bonneville			1	201		201
Clearwater			4	1,044	10	1,049
Custer			6	1,139	22	1,151
Elmore			2	286	4	288
Idaho			11	4,852	34	4,870
Latah			1	129	1	130
Lemhi			7	3,502	17	3,511
Owyhee		1	2	19,568	490	19,829
Shoshone			2	790	3	792
Twin Falls			3	418	2	419
Valley			1	358	2	359
		3	48	85,373	1,419	86,129
Total, 1928	1	3	52	169,336	2,538	170,821

MINING INDUSTRY

The general condition of the mining industry in Idaho was distinctly improved in 1929, and as a result the total value of the metal output increased nearly 17 per cent over that of 1928. In fact, the combined value of the five metals in 1929 was larger than that in any year since 1920. Although the production of lead increased substantially, the outstanding feature of the year was the increase of more than 46 per cent in the production of zinc. The newly constructed electrolytic zinc plant near Kellogg was operated continuously at a normal rate throughout the year; a large quantity of zinc concentrates, chiefly from the Coeur d'Alene region, was treated at this plant. Dividend payments in 1929 increased about 10 per cent; the Dayrock Mining Co. and the Golconda Lead Mines distributed dividends for the first time. According to printed reports of the three leading companies, ore reserves at the Bunker Hill & Sullivan, Hecla, and Morning mines were less than those published at the close of 1928. Increased ore reserves, however, were reported at the Dayrock, Crescent, Sherman, Page, Constitution, Sunshine, and Jack Waite properties, all in Shoshone County. The Bunker Hill & Sullivan Mining & Concentrating Co., the Federal Mining & Smelting Co., and the Hecla Mining Co. curtailed production about 15 per cent during December, but normal production was maintained throughout the year at the other large mines.

There were several important installations of new mining equipment, chiefly by the Hecla Mining Co., and intensive development was carried on in the Coeur d'Alene region, as well as by many companies throughout the State.

ORE CLASSIFICATION

Ore, old tailings, etc., sold or treated in Idaho, 1920-1929, with content in terms of recovered metals

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	DRY AND SILICEOUS ORE					
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1920	39, 811	13, 806. 37	91, 752	50, 437	17, 540	------
1921	48, 221	13, 826. 54	49, 034	7, 084	16, 942	------
1922	25, 766	9, 084. 94	91, 377	19, 252	25, 995	------
1923	24, 059	6, 570. 14	67, 294	5, 535	29, 719	------
1924	19, 260	5, 808. 43	47, 137	1, 159	3, 086	------
1925	18, 135	4, 054. 53	124, 911	51, 041	235, 762	------
1926	5, 862	2, 995. 17	24, 335	3, 852	7, 495	------
1927	5, 268	4, 823. 28	23, 420	3, 192	7, 992	------
1928	10, 571	11, 195. 84	29, 203	5, 966	15, 162	------
1929	26, 583	12, 830. 06	30, 450	2, 575	16, 692	------
	COPPER ORE					
1920	19, 259	1, 418. 69	52, 029	1, 738, 541	420	------
1921	10, 322	1, 258. 62	23, 987	1, 105, 511	------	------
1922	32, 590	2, 045. 78	44, 550	2, 572, 335	707	------
1923	41, 901	1, 516. 80	74, 247	2, 794, 091	3, 517	------
1924	37, 634	2, 407. 47	504, 644	1, 989, 050	131, 204	------
1925	51, 004	2, 785. 20	711, 874	2, 738, 861	33, 678	------
1926	28, 258	431. 64	429, 343	586, 387	42, 512	------
1927	27, 742	794. 38	49, 623	1, 030, 348	7, 000	------
1928	31, 454	559. 38	262, 938	1, 058, 944	39, 833	------
1929	91, 782	2, 371. 41	68, 410	3, 777, 080	3, 000	------
	LEAD ORE					
1920	1, 480, 177	2, 497. 21	6, 091, 408	657, 627	210, 039, 183	------
1921	1, 446, 710	2, 467. 70	5, 688, 577	449, 883	198, 322, 374	------
1922	1, 331, 785	2, 590. 10	5, 450, 038	399, 160	193, 551, 305	1, 699, 261
1923	1, 192, 442	2, 066. 00	5, 489, 477	594, 748	191, 685, 757	------
1924	1, 254, 212	1, 061. 00	5, 815, 764	672, 154	201, 074, 111	151, 453
1925	1, 088, 564	1, 048. 63	4, 791, 497	272, 978	175, 631, 005	------
1926	1, 084, 345	1, 455. 74	4, 575, 490	430, 937	183, 074, 616	------
1927	1, 308, 987	1, 828. 47	5, 609, 605	735, 175	220, 178, 217	235, 768
1928	1, 138, 581	487. 92	4, 623, 567	443, 604	173, 763, 525	1, 427, 429
1929	1, 021, 203	233. 34	4, 706, 508	458, 894	177, 031, 191	4, 073, 416

Ore, old tailings, etc., sold or treated in Idaho, 1920–1929, with content in terms of recovered metals—Continued

COPPER-LEAD ORE

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1920	5, 015	95. 83	225, 181	69, 791	225, 308	------------
1921	9, 122	61. 97	317, 244	125, 717	129, 803	------------
1922	26, 143	1, 635. 00	459, 529	292, 095	333, 045	------------
1923	52, 291	2, 587. 09	917, 215	546, 343	1, 167, 818	------------
1924	3, 962	12. 21	140, 423	53, 387	536, 356	------------
1925	6, 275	26. 31	230, 584	90, 477	1, 233, 092	------------
1926	22, 037	33. 98	445, 520	116, 124	717, 352	------------
1927	40, 125	1. 12	1, 079, 747	264, 399	1, 316, 757	------------
1928	49, 273	. 46	1, 146, 294	176, 210	1, 345, 312	------------
1929	84, 138	6. 48	2, 017, 528	379, 062	1, 960, 613	------------
ZINC ORE, COPPER-LEAD-ZINC ORE, COPPER-ZINC ORE, AND LEAD-ZINC ORE						
1920	414, 139	166. 56	865, 305	22, 000	39, 327, 525	27, 932, 326
1921	72	------------	------------	------------	------------	33, 463
1922	20, 600	------------	34, 412	------------	1, 923, 153	2, 409, 870
1923	452, 827	259. 20	1, 118, 813	38, 914	49, 468, 922	27, 952, 749
1924	396, 920	308. 59	1, 280, 938	23, 074	47, 205, 535	15, 189, 045
1925	663, 737	279. 33	1, 881, 761	144, 086	75, 908, 253	31, 237, 240
1926	793, 641	392. 29	2, 079, 727	200, 142	89, 138, 237	52, 614, 691
1927	636, 203	348. 09	2, 136, 708	140, 049	80, 528, 457	53, 320, 577
1928	824, 450	545. 15	2, 933, 790	387, 441	115, 482, 073	61, 099, 219
1929	950, 419	675. 90	2, 590, 088	513, 827	118, 377, 992	87, 277, 391

Ore, old tailings, etc., sold or treated in Idaho in 1929, with content in terms of recovered metals

Source	Mines producing	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	37	26, 459	12, 709. 23	15, 886	1, 456	10, 851	------------
Dry gold and silver ore	1	7	81. 24	3, 934	------------	------------	------------
Dry silver ore	8	117	39. 59	10, 630	1, 119	5, 841	------------
Copper ore	11	91, 782	2, 371. 41	68, 410	3, 777, 080	3, 000	------------
Lead ore	67	[1] 1, 021, 203	233. 34	4, 706, 508	458, 894	177, 031, 191	4, 073, 416
Zinc ore	1	5	------------	5	------------	220	3, 732
Copper-lead ore	5	84, 138	6. 48	2, 017, 528	379, 062	1, 960, 613	------------
Lead-zinc ore	32	[2] 950, 414	675. 90	2, 590, 083	513, 827	118, 377, 772	87, 273, 659
Total, lode mines	[3] 147	2, 174, 125	16, 117. 19	9, 412, 984	5, 131, 438	297, 389, 488	91, 350, 807
Total, placers	51	------------	4, 129. 92	1, 419	------------	------------	------------
	198	2, 174, 125	20, 247. 11	9, 414, 403	5, 131, 438	297, 389, 488	91, 350, 807
Total, 1928	207	2, 054, 329	20, 980. 38	8, 998, 330	2, 072, 165	290, 645, 905	62, 526, 648

[1] Includes 1 ton of mill cleanings and 36 tons of old tailings sold to a smelter and 12,000 tons of old tailings concentrated.

[2] Includes 29,133 tons of old tailings concentrated.

[3] A mine producing more than one class of ore is counted but once in arriving at total for all classes.

Value of metals from ore, old tailings, etc., sold or treated in Idaho in 1929, by classes of ore

Class	Ore, old tailings, etc. (short tons)	Gold	Silver	Copper	Lead	Zinc	Total value
Dry gold ore	26, 459	$262, 723	$8, 467	$256	$683	------------	$272, 129
Dry gold and silver ore	7	1, 680	2, 097	------------	------------	------------	3, 777
Dry silver ore	117	818	5, 666	197	368	------------	7, 049
Copper ore	91, 782	49, 021	36, 463	664, 766	189	------------	750, 439
Lead ore	1, 021, 203	4, 824	2, 508, 569	80, 765	11, 152, 965	$268, 845	14, 015, 968
Zinc ore	5	------------	3	------------	14	246	263
Copper-lead ore	84, 138	134	1, 075, 342	66, 715	123, 519	------------	1, 265, 710
Lead-zinc ore	950, 414	13, 972	1, 380, 514	90, 434	7, 457, 800	5, 760, 062	14, 702, 782
	2, 174, 125	333, 172	5, 017, 121	903, 133	18, 735, 538	6, 029, 153	31, 018, 117
Total, 1928	2, 054, 329	264, 367	5, 262, 538	298, 392	16, 857, 462	3, 814, 126	26, 496, 885

GOLD ORE

The output of gold ore from 37 mines in Idaho in 1929 was more than double the output reported from 46 mines in 1928. Nearly 79 per cent of the ore was produced from two mines in the Boise Basin district, Boise County—the Gold Hill & Iowa mine near Quartzburg and the Idawa mine near Placerville. The Unity Mines Co. at Warren, Idaho County, the Sunnyside Mining & Milling Co., near Cascade, Valley County, the Mountain Chief property, near Quartzburg, Boise County, and the Lone Pine mine, at Golden, Idaho County, also produced considerable gold ore. The ore yielded $9.93 in gold and 0.60 ounce of silver to the ton and a small quantity of copper and lead.

SILVER ORE

Small lots of silver ore were mined in 1929 at Talache, Silver City, Vienna, and Leadore, but most of it came from a property about 30 miles north of Stanley, in Custer County. The silver ore of the State as a whole yielded $6.99 in gold and 90.85 ounces of silver to the ton, 0.48 per cent of copper, and 2.50 per cent of lead.

COPPER ORE

The output of copper ore from 11 mines in Idaho in 1929 was nearly three times that reported from 10 mines in 1928; most of it (72.5 per cent) came from the property of the Mackay Metals (Inc.) in Custer County and nearly all the remainder from two mines in Lemhi County. More than 82 per cent of the total copper ore was concentrated. The output of copper ore from the property of the Mackay Metals (Inc.) increased considerably in 1929; the output of copper ore from the properties of the Winder-Stillman Consolidated and the Harmony Mines Co., in Lemhi County, also increased. The largest producers of copper ore in Idaho in 1929 were the Mackay Metals (Inc.), the Winder-Stillman Consolidated (Pope-Shenon mine), and the Harmony properties. In 1928 a large quantity of copper ore containing considerable silver was produced at the Crescent mine in Shoshone County, but in 1929 the lead content increased so that the product was classified as a copper-lead ore. The average recovered content of the copper ore shipped or treated in 1929 was 53.4 cents in gold and 0.745 ounce of silver to the ton, 2.058 per cent of copper, and a little lead.

LEAD ORE

Lead ore has been the most valuable mine product of Idaho from the time the Coeur d'Alene region became productive to 1928, but in 1929 lead-zinc ore was the most valuable product; lead ore was valued at $14,015,968 and lead-zinc ore at $14,702,782. The total output of lead ore and old tailings from 67 producers in 1929 was 10 per cent less than the output from 62 producers in 1928, and 92 per cent of it was ore and old tailings of concentrating grade from 8 producers in Shoshone County; operators in Custer, Butte, and Bonner Counties also mined and shipped much lead ore. The Bunker Hill & Sullivan property at Kellogg, in Shoshone County, produced nearly half the total output of lead ore, followed by the Hecla mine at Burke, the Gold Hunter mine at Mullan, the Sherman mine at Burke, and the Dayrock property north of Wallace, all in Shoshone County. The Livingston mine in Custer County led the mines in the other counties. Two mines in Idaho produced from lead ore alone 47 per cent of the State's total lead in 1929. The average recovered content of the lead ore and old tailings in 1929 was 4.61 ounces of silver to the ton, 0.02 per cent of copper, 8.67 per cent of lead, and 0.20 per cent of zinc.

COPPER-LEAD ORE

Five mines reported the output of 84,138 tons of copper-lead ore in Idaho in 1929. This was nearly double the quantity produced by two mines in 1928. The increase was due chiefly to the fact that the ore from the Crescent mine contained enough lead in 1929 to be classified as copper-lead ore, whereas in 1928 it was classified as copper ore. There was also a notable increase in the output of copper-lead ore from the Sunshine (Yankee Boy) mine. The ore in the vicinity of Big Creek consists of galena and tetrahedrite, and as the latter increases the silver and copper are correspondingly increased. Nearly all the copper-lead ore in 1929 came from two properties near Kellogg, in Shoshone County, and nearly all of it was concentrated; the total output yielded 23.98 ounces of silver to the ton, 0.225 per cent of copper, and 1.165 per cent of lead.

ZINC ORE

A small quantity of first-class zinc ore was produced in 1929 from a property near Hailey, in Blaine County.

LEAD-ZINC ORE

In 1929 lead-zinc ore was the most valuable mine product of Idaho, even exceeding lead ore which was formerly the most valuable product. Since the advent of differential flotation an increased quantity of mixed ore has been mined and treated each year, which resulted in a record output of zinc in 1929. The output of lead-zinc ore and old tailings from 32 mines and dumps in Idaho in 1929 increased more than 15 per cent, and all of it was concentrated. The Morning mine in Shoshone County produced nearly half the total; other large producers were the Star, Page, Tamarack & Custer, Golconda, Sidney, Jack Waite, Frisco, and Triumph properties, all in Shoshone County except the Triumph, which is in Blaine County. The lead-zinc ore and old tailings yielded 2.725 ounces of silver to the ton, 0.027 per cent of copper, 6.23 per cent of lead, and 4.59 per cent of zinc.

Ore, old tailings, etc., sold or treated in Idaho in 1929, by counties, with content in terms of recovered metals

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
DRY GOLD ORE						
Ada	13	22.59	9			
Blaine	1	.88	2	10		
Boise	21,779	9,997.52	8,613	958	4,182	
Camas	56	40.48	168	323	3,330	
Custer	7	40.66	403			
Elmore	17	24.89	17			
Gem	294	54.26	497	90	2,476	
Idaho	2,898	2,034.67	3,225	75	584	
Lemhi	202	127.95	208		279	
Owyhee	192	179.27	2,626			
Valley	1,000	186.06	118			
	26,459	12,709.23	15,886	1,456	10,851	
Total, 1928	10,304	11,149.07	22,002	5,754	14,243	
DRY SILVER ORE						
Blaine	6	1.00	962	21		
Boise	3	.05	73			
Bonner	23	1.77	1,515	309	183	
Custer	81	27.30	6,582	775	5,600	
Lemhi	1		340	14	58	
Owyhee	3	9.47	1,158			
	117	39.59	10,630	1,119	5,841	
Total, 1928	66	9.40	5,095	212	919	
COPPER ORE						
Adams	42	5.31	311	26,512		
Custer	66,576	2,282.45	60,912	2,824,241	1,000	
Latah	44	1.00	35	8,270		
Lemhi	24,961	81.65	2,216	908,607		
Shoshone	7		52	1,626		
Washington	152	1.00	4,884	7,824	2,000	
	91,782	2,371.41	68,410	3,777,080	3,000	
Total, 1928	31,454	559.38	262,938	1,058,944	39,833	
LEAD ORE						
Bear Lake	89		203		126,514	
Blaine	139	9.63	10,361	980	84,117	
Bonner	11,811	2.80	88,709	684	1,724,902	
Boundary	16		83	122	7,297	
Butte	14,412	3.55	56,375	46	3,751,144	
Clark	13		48		9,164	
Custer	25,627	128.26	150,220	3,404	4,590,517	
Gem	6	5.40	84		1,654	
Lemhi	[1] 2,379	70.31	13,418	2,992	694,329	
Shoshone	[2] 966,670	12.77	4,386,679	450,666	166,007,442	4,073,416
Washington	41	.62	328		34,111	
	1,021,203	233.34	4,706,508	458,894	177,031,191	4,073,416
Total, 1928	1,138,581	487.92	4,623,567	443,604	173,763,525	1,427,429
COPPER-LEAD ORE						
Blaine	20	0.20	164	920	3,036	
Custer	114	1.27	28,440	8,978	82,018	
Lemhi	8	5.01	297	3,206	974	
Shoshone	83,996		1,988,627	365,958	1,874,585	
	84,138	6.48	2,017,528	379,062	1,960,613	
Total, 1928	49,273	.46	1,146,294	176,210	1,345,312	

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[1] Includes 1 ton of mill cleanings sold to a smelter.

[2] Includes 36 tons of old tailings sold to a smelter and 12,000 tons of old tailings concentrated.

Ore, old tailings, etc., sold or treated in Idaho in 1929, by counties, with content in terms of recovered metals—Continued

LEAD-ZINC ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Blaine	26,667	190.05	170,474	2,011	2,985,598	4,979,995
Bonner	111	1.00	581		2,406	2,718
Shoshone	[3]920,907	459.65	2,401,365	502,450	115,233,309	82,018,878
Valley	2,729	25.20	17,663	9,366	156,459	272,068
	950,414	675.90	2,590,083	513,827	118,377,772	87,273,659
Total, 1928	823,951	544.22	2,933,150	386,059	115,474,596	61,018,192

[3] Includes 29,133 tons of old tailings concentrated.

Zinc products (as marketed from Idaho mines and mills) sold to smelters or electrolytic plants in 1929

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of concentrates	Recovered zinc
		Short tons	*Pounds*	*Per cent*	*Pounds*
Zinc concentrates	Blaine, Bonner, Shoshone, and Valley.	89,004	89,740,121	50.41	79,848,103
Lead-zinc concentrates	Shoshone	15,024	13,158,183	43.79	11,502,704
		104,028	102,898,304	49.46	91,350,807
Total, 1928		74,453	72,578.263	48.74	62,526,648

METALLURGIC INDUSTRY

The adoption of flotation as a method of concentration for Idaho ores has resulted in steady improvement in milling methods, particularly in the treatment of complex lead-zinc ores. The general practice several years ago was to use flotation as a supplementary treatment following various gravity methods, but during the past two or three years there has been a decided trend toward the adoption of straight flotation. Milling advances during 1929 constituted a continuation of this trend, and the principal developments were as follows: New straight flotation plants were built at the Whitedelf mine, at the Hall-Interstate project of the Bunker Hill & Sullivan Mining & Concentrating Co., and at the Little Pittsburgh mine of the Pine Creek Lead-Zinc Mining Co.; the straight flotation mills of the Hercules Mining Co. and the Sunshine Mining Co. and the Page mill of the Federal Mining & Smelting Co. were rebuilt, and modern flotation equipment was installed, increasing the capacity of the plants; the mill of the Jack Waite Consolidated Mining Co. and the Sweeny mill of the Bunker Hill & Sullivan Mining & Concentrating Co., formerly combined gravity and flotation mills, were converted to all-flotation plants; part of the gravity equipment in the Hecla mill was replaced by flotation machines; and additional flotation equipment was added to the West mill of the Bunker Hill & Sullivan Mining & Concentrating Co. at Kellogg.

New construction work at metallurgical plants other than the foregoing included the erection of an electrolytic cadmium plant at the zinc plant of the Sullivan Mining Co. at Silver King and the enlargement of the lead-silver refinery department of the Bunker Hill smelter at Bradley to nearly double its former capacity. This latter improvement was necessary to enable the Bunker Hill & Sullivan Mining & Concentrating Co. to refine locally all the lead bullion made from the entire product of the Bunker Hill mine and custom material, as the contract with the American Smelting & Refining Co. to treat part of its product expired early in 1930.

In Idaho 47 milling plants of all kinds were active in 1929, compared with 49 plants in 1928. Of these mills 33 were concentration plants, of which 4 used flotation machines with gravity concentration devices, 23 used flotation alone, and 6 used jigs and tables without flotation cells; 10 used amalgamation alone; 2 used amalgamation with concentration tables; and 2 used amalgamation with flotation cells. Besides the milling plants there was one electrolytic leaching plant that treated zinc concentrates. The following table lists the important mills that were active in 1929:

Mills in Idaho active in 1929 [1]

Name of company	Location of mill	Method of treatment	Rated capacity of mill	Ore and old tailings treated	Concentrates produced
			Short tons per day		
Whitedelf Mining & Development Co.	Clark Fork	Flotation	75	Lead	Lead.
Wilbert Mining Co	Howe	Gravity	60	do	Do.
Mackay Metals (Inc.)	Mackay	Flotation	220	Copper	Copper.
Livingston Mines Corporation.	Clayton	Gravity and flotation.	300	Lead	Lead.
Winder-Stillman Copper Co	Salmon	Flotation	150	Copper	Copper.
Bunker Hill & Sullivan Mining & Concentrating Co.:					
West mill	Kellogg	Gravity and flotation.	1,300	Lead	Siliceous silver (iron), lead, and zinc.
Sweeny custom mill	Bradley	Flotation	200	Lead-zinc	Lead, lead-zinc, and zinc.
Crescent mill	Shont	do	120	Copper-lead	Copper-lead.
South mill	Kellogg	do	500	Lead-zinc	Lead and zinc.
Callahan Zinc-Lead Co	Wallace	do	150	Lead	Lead.
Constitution Mining & Milling Co.	Masonia	do	150	Lead-zinc	Lead-zinc.
Dickens Consolidated Mines Co.	Osburn	do	150	do	Lead and zinc.
Federal Mining & Smelting Co.:					
Morning mill	Mullan	do	1,200	do	Do.
Page mill	Kellogg	do	300	do	Do.
Hull mill	Gem	do	75	do	Do.
Golconda Lead Mines (Inc.)	Wallace	do	200	do	Do.
Gold Hunter Mines (Inc.)	Mullan	do	500	Lead	Lead.
Hecla Mining Co	Gem	Gravity and flotation.	750	do	Lead and lead zinc.
Hercules Mining Co. (custom mill).	Wallace	Flotation	800	Lead and lead-zinc.	Lead, lead-zinc, and zinc.
Jack Waite Consolidated Mining Co.	Prichard	do	150	Lead-zinc	Lead and zinc.
Sunshine Mining Co	Shont	do	350	Copper-lead	Copper-lead.

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[1] 12 small mills operating intermittently in 1929 are not included.

In 1929 a little more than 1 per cent of the total ore and old tailings, or 25,797 tons of ore, was treated in gold and silver mills; the gold and silver recovered were valued at $244,756, or $9.49 per ton of material treated. The companies used 1,011 pounds of quicksilver in 1929, an average of 0.039 pound per ton of ore amalgamated and 0.052 pound per ounce of gold and silver bullion saved.

Mine production of metals from gold and silver mills in Idaho in 1929, by counties, in terms of recovered metals

County	Ore and old tailings treated (dry weight)		Recovered in bullion			
			Amalgamation		Cyanidation	
	Ore	Old tailings	Gold	Silver	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Ada	9		11.99	3		
Boise	21,654		9,258.93	2,342		
Custer	4		14.66	36		
Elmore	17		19.23	12	5.66	5
Idaho	2,898		1,929.31	1,091		
Lemhi	201		106.85	21		
Owyhee	14		107.10	3,980	4.00	6
Valley	1,000		186.06	118		
	25,797		11,634.13	7,603	9.66	11
Total, 1928	10,003	51	8,459.24	3,277	1.47	206

County	Concentrates and recovered metal				
	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Boise	593	656.25	5,189	846	2,461
Idaho	14	105.36	2,134	75	584
Lemhi	2	5.60	6		279
	609	767.21	7,329	921	3,324
Total, 1928	685	905.14	10,324	4,170	7,793

Of the total ore and old tailings 2,100,734 tons, or 96.6 per cent, was concentrated. For 1929 exact figures were obtained giving the gross content of the mill feed. The results are presented in the accompanying tables, where they are separated by classes of ore, methods of concentration, and classes of concentrates produced. A table of metallurgical recoveries on ore concentrated is also given. Nearly 64 per cent of the ore concentrated was treated by straight flotation, 35 per cent by combined gravity and flotation, and less than 1 per cent by gravity without flotation equipment. The average assay of the lead ore treated by all methods was a trace of gold and 4.50 ounces of silver to the ton, 0.03 per cent of copper, 9.11 per cent of lead, and 1.03 per cent of zinc; the average assay of the lead-zinc ore treated by all methods was a trace of gold and 3.07 ounces of silver to the ton, 0.044 per cent of copper, 7.53 per cent of lead, and 6.51 per cent of zinc.

Idaho ore and old tailings concentrated in 1929, by classes of ore, etc., methods of concentration, and classes of concentrates

Class of material concentrated	Method of concentration	Ore and old tailings concentrated	Gross content of mill feed				
			Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore:							
Siliceous gold	Flotation	294	68.00	620	140	3,500	
Copper sulphide	do	75,597	2,318.40	40,979	3,272,409		
Copper-lead sulphide	do	83,996		2,085,684	575,951	2,062,907	
Lead sulphide	do	234,978	12.40	951,251	153,200	28,816,140	
Lead-zinc sulphide	do	[1] 921,286	1,093.82	2,827,343	810,493	138,683,082	119,863,721
		1,316,151	3,492.62	5,905,877	4,812,193	169,565,629	119,863,721
Siliceous gold	Gravity and flotation	180	154.74	3,027			
Lead sulphide	do	727,280	183.00	3,378,295	522,000	144,007,112	20,268,896
		727,460	337.74	3,381,322	522,000	144,007,112	20,268,896
Do	Gravity	15,785	15.00	75,815	370	5,280,911	
Other ore	do	[2] 205	57.65	439	21,194	41	
		15,990	72.65	76,254	21,564	5,280,952	
Total ore		2,059,601	3,903.01	9,363,453	5,355,757	318,853,693	140,132,617
Old tailings:							
Lead sulphide	Gravity and flotation	12,000	.50	28,460	14,200	810,400	
Lead-zinc sulphide	Flotation	29,133		49,300		1,462,350	3,440,667
Total old tailings		41,133	.50	77,760	14,200	2,272,750	3,440,667
Grand total		[3] 2,100,734	3,903.51	9,441,213	5,369,957	321,126,443	143,573,284

Class of material concentrated	Method of concentration	Concentrates produced		Gross content of concentrates				
		Class	Quantity	Gold	Silver	Copper	Lead	Zinc
			Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore:								
Siliceous gold	Flotation	Siliceous gold	42	54.26	497	112	2,606	
Copper sulphide	do	Copper sulphide	5,668	1,360.45	24,485	2,692,756		
Copper-lead sulphide	do	Copper-lead sulphide	3,940		1,988,627	518,834	1,973,246	

Lead sulphide	do	Lead sulphide	23,281	9.49	820,899	114,651	24,486,329	------
Lead-zinc sulphide	do	do	[4]86,174	252.85	2,118,704	282,752	115,547,115	------
		Lead-zinc sulphide	13,022	112.79	103,518	98,874	3,096,305	11,579,011
		Zinc sulphide	[5]82,802	310.26	326,921	220,849	5,075,218	83,993,176
			181,998	675.90	2,549,143	602,475	123,718,638	95,572,187
			214,929	2,100.10	5,383,651	3,928,828	150,180,819	95,572,187
Siliceous gold	Gravity and flotation	Siliceous gold	1	123.79	2,422	------	------	------
Lead sulphide	do	Siliceous silver	11,148	------	37,054	22,022	979,778	------
		Lead sulphide	105,153	128.03	3,033,761	370,460	130,254,748	------
		Lead-zinc sulphide	1,727	------	17,768	5,000	367,776	1,364,988
		Zinc sulphide	3,448	------	19,339	20,000	260,055	3,266,945
			121,476	128.03	3,107,922	417,482	131,862,357	4,631,933
			121,477	251.82	3,110,344	417,482	131,862,357	4,631,933
Do	Gravity	Lead sulphide	3,427	7.55	59,773	217	4,198,857	------
Other ore	do	Siliceous gold, siliceous silver, and copper.	[6]36	50.82	315	16,151	33	------
			3,463	58.37	60,088	16,368	4,198,890	------
Total from ore	------	------	339,869	2,410.29	8,554,083	4,362,678	286,242,066	100,204,120
Old tailings:								
Lead sulphide	Gravity and flotation	Lead sulphide	661	.29	22,728	7,782	485,252	------
Lead-zinc sulphide	Flotation	do	922	------	32,264	------	1,046,762	------
		Lead-zinc sulphide	275	------	1,358	------	34,680	214,184
		Zinc sulphide	2,754	------	7,323	------	150,130	2,480,000
Total from old tailings	------	------	4,612	.29	63,673	7,782	1,716,824	2,694,184
Grand total	------	------	[7]344,481	2,410.58	8,617,756	4,370,460	287,958,890	102,898,304

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[1] Includes 5 tons of zinc ore containing 11 ounces of silver, 494 pounds of lead, and 5,321 pounds of zinc.

[2] Includes 102 tons of siliceous gold ore, 3 tons of siliceous silver ore, and 100 tons of copper ore.

[3] Figures do not include 10,196 tons of siliceous gold ore first treated by amalgamation.

[4] Includes 22 tons of iron concentrates (siliceous silver).

[5] Includes 3 tons of zinc concentrates from zinc ore.

[6] Includes 2 tons of siliceous gold concentrates, 1 ton of siliceous silver concentrates, and 33 tons of copper concentrates.

[7] Figures do not include 609 tons of siliceous gold concentrates from ore first treated by amalgamation, containing 767.21 ounces of gold, 7,329 ounces of silver, 1,465 pounds of copper, and 3,500 pounds of lead.

Metallurgic results obtained by flotation of Idaho ore and by concentration of Idaho ore and old tailings in 1929

Material treated	Concentrates produced	Ratio of concentration	Per cent recovered in concentrates				
			Gold	Silver	Copper	Lead	Zinc
Ore by flotation:							
Siliceous gold	Siliceous gold	7. 00: 1	79. 79	80. 16	80. 00	74. 46	--------
Copper sulphide	Copper sulphide	13. 34: 1	58. 68	59. 75	82. 29	--------	--------
Copper-lead sulphide	Copper-lead sulphide	21. 32: 1	--------	95. 35	90. 08	95. 65	--------
Lead sulphide	Lead sulphide	10. 09: 1	76. 53	86. 30	74. 84	84. 97	--------
Lead-zinc sulphide	do	10. 69: 1	23. 12	74. 94	34. 89	83. 32	--------
	Lead-zinc sulphide	70. 75: 1	10. 31	3. 66	12. 20	2. 23	9. 66
	Zinc sulphide	11. 13: 1	28. 36	11. 56	27. 25	3. 66	70. 07
Total lead-zinc sulphide		5. 06: 1	61. 79	90. 16	74. 34	89. 21	79. 73
Total ore by flotation		6. 12: 1	60. 13	91. 16	81. 64	88. 57	79. 73
Total ore and old tailings by all methods.		6. 10: 1	61. 75	91. 28	81. 39	89. 67	71. 67

Metals recovered from the concentrates—from ore concentrated, from 41,133 tons of old tailings re-treated, and from part of the ore treated in gold and silver mills—were valued at $82.85 per ton of concentrates, compared with $76.21 in 1928. The concentrates came largely from the Coeur d'Alene region, where the ratio of concentration was 6.04 tons of ore and old tailings to 1 ton of concentrates. There were marked increases in the production of copper concentrates, copper-lead concentrates, lead-zinc concentrates, and zinc concentrates; the quantity of lead concentrates was substantially the same as that in 1928, but there was a decrease in the quantity of siliceous concentrates.

Operators in Shoshone County shipped an average of 26,819 tons of concentrates of various kinds a month, compared with 24,922 tons in 1928. This amount, with the crude ore shipped to smelters (2,317 tons a month), gives the Coeur d'Alene region an average monthly output of 29,136 tons of concentrates and crude ore, compared with 27,865 tons in 1928. The average value of metals recovered from lead concentrates increased from $83.86 to the ton of concentrates in 1928 to $90.49 in 1929, that from zinc concentrates from $58.29 to $65.37, and that from lead-zinc concentrates from $61.36 to $69.75. The average value of the copper-lead concentrates, which contained chiefly silver, decreased more than 23 per cent, and the average value of the copper concentrates also decreased considerably.

Mine production of metals from concentrating mills in Idaho in 1929, by counties, in terms of recovered metals

County	Ore and old tailings treated		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Blaine	26,672	----------	8,145	190.05	170,479	2,011	2,985,818	4,983,727
Boise	103	----------	2	5.65	77	----------	31	----------
Bonner	10,257	----------	666	2.50	36,773	349	732,238	2,718
Butte	14,355	----------	3,152	.85	55,864	46	3,739,113	----------
Custer	76,364	----------	8,591	1,466.21	172,030	1,737,566	4,556,745	----------
Gem	294	----------	42	54.26	497	90	2,476	----------
Lemhi	26,035	----------	1,642	67.50	5,021	893,363	172,079	----------
Owyhee	182	----------	2	129.73	2,511	----------	----------	----------
Shoshone	1,902,610	41,133	321,824	468.63	8,156,841	1,255,840	260,885,490	86,092,294
Valley	2,729	----------	415	25.20	17,663	9,366	156,459	272,068
	2,059,601	41,133	344,481	2,410.58	8,617,756	3,898,631	273,230,449	91,350,807
Total, 1928	1,819,982	179,529	314,309	1,301.60	7,999,699	1,822,757	262,014,674	62,526,648

Gross metal content of Idaho concentrates produced in 1929, by classes of concentrates

Class of concentrates	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	11,803	956.85	47,468	23,599	985,917	----------
Copper	5,701	1,399.68	24,634	2,708,907	----------	----------
Lead	219,618	398.21	6,088,129	775,862	276,019,063	----------
Zinc	89,004	310.26	353,583	240,849	5,485,403	89,740,121
Copper-lead	3,940	----------	1,988,627	518,834	1,973,246	----------
Lead-zinc	15,024	112.79	122,644	103,874	3,498,761	13,158,183
	345,090	3,177.79	8,625,085	4,371,925	287,962,390	102,898,304
Total, 1928	314,994	2,206.74	8,010,023	2,317,651	276,500,035	72,578,263

Mine production of metals from Idaho concentrates in 1929, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Blaine	8,145	190.05	170,479	2,011	2,985,818	4,983,727
Boise	595	661.90	5,266	846	2,492	----------
Bonner	666	2.50	36,773	349	732,238	2,718
Butte	3,152	.85	55,864	46	3,739,113	----------
Custer	8,591	1,466.21	172,030	1,737,566	4,556,745	----------
Gem	42	54.26	497	90	2,476	----------
Idaho	14	105.36	2,134	75	584	----------
Lemhi	1,644	73.10	5,027	893,363	172,358	----------
Owyhee	2	129.73	2,511	----------	----------	----------
Shoshone	321,824	468.63	8,156,841	1,255,840	260,885,490	86,092,294
Valley	415	25.20	17,663	9,366	156,459	272,068
	345,090	3,177.79	8,625,085	3,899,552	273,233,773	91,350,807
Total, 1928	314,994	2,206.74	8,010,023	1,826,927	262,022,467	62,526,648

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous	11,803	956.85	47,468	16,426	926,822	----------
Copper	5,701	1,399.68	24,634	2,627,639	----------	----------
Lead	219,618	398.21	6,088,129	568,716	262,205,812	----------
Zinc	89,004	310.26	353,583	220,353	4,997,373	79,848,103
Copper-lead	3,940	----------	1,988,627	365,958	1,874,585	----------
Lead-zinc	15,024	112.79	122,644	100,460	3,229,181	11,502,704

Of the total ore 2 per cent was shipped crude to smelters at Bradley, Idaho; East Helena and Anaconda, Mont.; Tacoma, Wash.; and plants near Salt Lake City, Utah. The total value of the metals recovered from first-class ore was $2,180,130, compared with $2,313,947 in 1928. Of the crude ore shipped to smelters 65 per cent was lead ore, and nearly all the remainder was copper ore; 64 per cent of the ore smelted was sulphide, although 98 per cent of the copper ore was carbonate.

Gross metal content of Idaho crude ore shipped to smelters in 1929, by classes of ore

Class of ore	Quantity (dry weight)	Gross metal content			
		Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous	207	229.44	12,422	1,991	13,538
Copper	16,085	971.73	43,776	1,185,670	4,100
Lead	31,123	80.90	694,872	97,064	25,313,681
Copper-lead	142	6.48	28,901	19,326	90,556
	47,557	1,288.55	779,971	1,304,051	25,421,875
Total, 1928	44,763	2,120.60	982,286	328,384	30,130,879

Mine production of metals from Idaho crude ore shipped to smelters in 1929, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Ada	4	10.60	6		
Adams	42	5.31	311	26,512	
Bear Lake	89		203		126,514
Blaine	166	11.71	11,489	1,931	87,153
Boise	25	76.74	1,078	112	1,690
Bonner	1,688	3.07	54,032	644	995,253
Boundary	16		83	122	7,297
Butte	57	2.70	511		12,031
Camas	56	40.48	168	323	3,330
Clark	13		48		9,164
Custer	16,037	999.07	74,491	1,099,832	122,390
Gem	6	5.40	84		1,654
Latah	44	1.00	35	8,270	
Lemhi	1,314	97.89	11,429	21,447	521,833
Owyhee	6	29.17	1,221		
Shoshone	27,801	3.79	619,570	64,810	22,217,897
Washington	193	1.62	5,212	7,824	36,111
	47,557	1,288.55	779,971	1,231,827	24,142,317
Total, 1928	44,763	2,120.60	982,286	245,238	28,623,438

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead
Dry and siliceous	207	229.44	12,422	1,564	10,861
Copper	16,085	971.73	43,776	1,149,441	3,000
Lead	31,123	80.90	694,872	67,718	24,042,428
Copper-lead	142	6.48	28,901	13,104	86,028

The combined value of the metals from concentrates and crude shipping ore was $30,772,193 in 1929, compared with $26,319,934 in 1928.

Miscellaneous material other than ore and old tailings milled and ore smelted was insignificant in 1929, and no ore was treated locally by either leaching or roasting methods.

REVIEW BY COUNTIES AND DISTRICTS

ADA COUNTY

Black Hornet district.—The output of the Black Hornet district consisted of small lots of rich gold ore from the Idaho group and similar material from the McCarty property. The Gold King and Delhi groups, 6 miles east of Boise on Cottonwood Creek, were being developed.

ADAMS COUNTY

Seven Devils district.—Two cars of sulphide copper ore were shipped from the Blue Jacket mine, which is 17 miles by road from Homestead, Oreg., a shipping point on the Oregon Short Line Railroad. The Red Ledge property, involved in litigation in 1928, was idle. Some development was done at the Wilford group of the National Copper Mines Co.

BEAR LAKE COUNTY

St. Charles district.—Two cars of sulphide lead ore were shipped from the Sunset property near St. Charles by the Sunset Mining Co. The ore averaged 72 per cent of lead but contained little silver.

BLAINE COUNTY

The value of the production of metals in Blaine County increased from $504,596 in 1928 to $624,377 in 1929, entirely the result of the large increase in the shipments of lead-zinc ore from the Triumph mine, which adjoins the North Star property of the Federal Mining & Smelting Co. The output of all metals increased, and the increase in lead and zinc was notable. From 1880 to 1929 Blaine County has produced $2,572,784 in gold, $16,599,324 in silver, $67,986 in copper, $9,423,002 in lead, and $1,321,313 in zinc, a total of $29,984,409. The quantities of the various metals follow: Gold, 124,460.17 fine ounces; silver, 18,357,118 fine ounces; copper, 392,694 pounds; lead, 207,752,921 pounds; and zinc, 18,547,566 pounds. In 1929 Blaine County ranked third in value of mine production in Idaho, following Shoshone and Custer Counties.

A recent bulletin[4] describes the geology and ore deposits in the vicinity of Hailey and Ketchum and also gives the early production of some of the important mines.

Lava Creek district.—A car of copper-lead ore containing silver was shipped from the Pandora group by way of Arco.

Little Wood River district.—A small lot of silver-lead ore was shipped by the United Mines Co. of Idaho, working property near Muldoon, where a 50-ton jig concentrator was installed. A sample lot of silver-lead ore was also marketed from the Silver Bar property.

Mineral Hill district (Hailey).—Eight lode mines in the Mineral Hill district produced 100 tons of ore, yielding $79 in gold, 6,926 ounces of silver, 371 pounds of copper, 52,498 pounds of lead, and 7,132 pounds of zinc, valued in all at $7,614, or $76.14 in metals a ton. With the exception of 25 tons of concentrating ore the output consisted chiefly of sulphide lead ore shipped directly to a smelter. The output from the region near Hailey, which was exceptionally small in 1929, was made up of sample lots from the Silver Bar, Hope, Jennie R., Lone Pine Tree, Minnie Moore, Ohio, and Wonder claims. The Star property was worked by a lessee who shipped two cars of first-class lead ore to Utah for smelting and one car of lead-zinc ore to Bauer, Utah, for custom milling. The Liberty Gem property, 8 miles west of Hailey, on the highway to Fairfield, was being developed by a 125-foot shaft and by crosscuts, aggregating 200 feet, on the 50 and 125 foot levels. The property is said to have considerable ore containing galena and sphalerite (which can readily be separated by flotation) and a vein containing rich gold ore. The Badger group, adjoining the Liberty Gem, was also being prospected by a 60-foot shaft and by 240 feet of lateral work, as well as by churn drilling; it is under lease and option to the Hercules Mining Co., of Wallace.

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[4] Umpleby, Joseph B., Westgate, Lewis G., and Ross, Clyde P., Geology and Ore Deposits of the Wood River Region, Idaho: U. S. Geol. Survey Bull. 814, 1930, 250 pp.

Vienna district.—The Vienna group, northwest of Ketchum, produced a test shipment of lead ore containing considerable silver. The property was being developed throughout the year, and about 500 feet of drifting and 150 feet of raising were done.

Warm Springs district (*Ketchum*).—Eight lode mines in the Warm Springs district produced 26,699 tons of ore, yielding $4,058 in gold, 173,753 ounces of silver, 2,587 pounds of copper, 3,013,056 pounds of lead, and 4,976,595 pounds of zinc, valued in all at $615,401, or $23.05 in metals a ton. Of this output 52 tons (nearly all lead ore) was first-class ore shipped to a smelter, and 26,647 tons was lead-zinc ore of milling grade, which yielded 8,135 tons of concentrates. Most of the output was lead-zinc ore from the Triumph property and consisted chiefly of sphalerite and galena; it was shipped to the flotation plant of the Combined Metals Reduction Co. at Bauer, Utah, where it was separated into lead concentrates and zinc concentrates. The Triumph mine ranked sixth as a producer of zinc in Idaho in 1929 and was also a large producer of silver and lead. The property is opened by a vertical shaft and various drifts, and development in 1929 consisted of 300 feet of inclined winze and 1,000 feet of drifts. Ore was said to have been opened close to the adjoining property, the North Star mine of the Federal Mining & Smelting Co. Recent improvements included a new boarding house, several new homes, and considerable mining equipment. The tramway, 4 miles long, completed by an allied company, takes the ore from the mine to the loading station on the railroad at Triumph below Ketchum. The property was not only the largest producer of silver, lead, and zinc in Blaine County in 1929, but recent development is said to have opened large reserves of ore containing galena and sphalerite. The North Star property was practically idle, but more than 400 tons of silver-lead-zinc ore was shipped to Midvale, Utah, to be tested by flotation. The mine, however, is not exhausted and with favorable market conditions and modern mill practice might again become an important producer. The old North Star concentration plant, used last on Independence lead ore, was idle, and ore extracted from the mine was taken out by lessees. Several cars of ore were shipped from the Independence and Trapper properties and small test lots from the Big Chief, Milligan, and Rocky Point.

BOISE COUNTY

The value of the production of metals in Boise County increased from $246,856 in 1928 to $265,261 in 1929 as a result of the large production of siliceous gold ore from the Gold Hill & Iowa mine of the Talache Mines (Inc.), which became the second largest producer of gold in Idaho after being idle since 1926. The Idawa Gold Mining Co. decreased its production of gold considerably but maintained its position as the largest gold producer in Idaho. The placer production was valued at $53,530, an increase of $10,287 over that of 1928, due partly to the increased output of the dredge at Centerville, operated by the Idaho Gold Dredging Corporation.

Banner district.—The Crooked River Mining Co. treated gravel deposits on Crooked River, 20 miles north of Idaho City. The property is equipped with a Diesel engine and a dredge which has a capacity of 1,500 cubic yards a day and which treated 30,000 cubic yards of gravel in 1929. A sample lot of concentrates containing silver was marketed from the Edna property, but the mine was not vigorously worked in 1929.

Boise Basin district (*Centerville, Placerville, Idaho City, Pioneerville.*)—Nine placers and seven lode mines in the Boise Basin district produced 21,779 tons of ore, $255,798 in gold, 9,326 ounces of silver, 958 pounds of copper, and 4,182 pounds of lead, valued in all at $261,202. The ore had an average value of $9.72 in metals a ton. The placer output consisted of $49,131 in gold and 713 ounces of silver, valued together at $49,511. Nearly all the ore (21,654 tons) was treated by amalgamation, and the resulting bullion contained 9,258.93 ounces of gold and 2,342 ounces of silver. The greater part of the gold was produced from the Belshazzar mine at Placerville, operated by the Idawa Gold Mining Co., and from the Gold Hill & Iowa property at Quartzburg, operated by the Talache Mines (Inc.). The ore from the Belshazzar mine, which contains gold, pyrite, arsenopyrite, and bismuthinite, was treated in a 30-ton mill equipped with amalgamation plates and Wilfley tables. Gold bullion was sent to the Boise assay office in 1929, and several hundred tons of concentrates containing gold and silver were shipped to the smelter at Midvale, Utah. In 1929 a dividend of $24,000 was paid, which, added to the initial dividend of $56,000 distributed in 1928, makes a total of $80,000 paid to date. There was a decrease of about 25 per cent in the output of the Belshazzar property in 1929, although the company spent $8,000 in drifting and tunneling. The company had some legal trouble in regard to high-grade material alleged to have been taken from the mine. The mill ore averages about $20 a ton, but much richer specimen material occurs which contains gold associated with crystals of arsenopyrite.

The Gold Hill & Iowa mine, a large producer of gold in the early days of mining in Idaho and as recently as 1924, was unwatered and worked by the Talache Mines (Inc.). The mine is opened to a depth of 700 feet, and sinking was in progress from the 700 to the 850 foot level. The ore contains free gold, which is associated with a lead bismuth mineral, but part of it is in such minute particles that fine grinding is necessary. The 125-ton mill is an amalgamation plant equipped with crusher, rolls, Hardinge mill, amalgamation plates, tables, and regrinding mill. The entire mill feed is ground in an 8-foot Hardinge ball mill in closed circuit with a 28-mesh screen. The screen undersize advances to the primary amalgamation plates, the overflow from which is classified in a 6-foot Dorr classifier. The sands return to the ball mill, and the overflow advances to four Wilfley tables, making final tailings and gold-bearing lead-bismuth concentrates. These concentrates are reground in a small cylindrical ball mill and reamalgamated on secondary plates, the overflow passing to the tailings. The mill was started in April, and bullion valued at about $93,000 was sent to the Boise assay office. In sinking the shaft the gold was found to be free even below the 700-foot level, and it is hoped that with further development at depth the mine may be brought to its former state of productivity. In 1921 the property produced gold valued at $243,000.

The Federated Mines Co. operated the Mountain Chief group at Placerville part of the year, but after the mill was completed and operated the company was involved in financial difficulties and work was suspended late in the summer. Several hundred tons of ore were treated by a combination of amalgamation and concentration; the bullion was marketed at Boise and several cars of concentrates containing gold and silver were shipped to Midvale, Utah. A car of rich gold ore containing considerable silver was shipped from the Comeback mine near Pioneerville, where 625 feet of tunnel work was done. A little gold bullion was recovered from the Mascot & Sunshine and Big Ben properties. A small quantity of gold ore from the Hay Fork mine was milled at a table concentrator and the resulting concentrates were shipped to the smelter at Midvale, Utah. The Missouri Mining Co. (Ltd.), operating the Native Missourian property at Pioneerville, did about 500 feet of development in sinking, drifting, and crosscutting and constructed a 75-ton flotation mill, but no products were marketed. The Mineral Mining Co. made no shipments but continued development at the Smuggler property and purchased equipment for remodeling and increasing the capacity of the milling plant. The Penn Mining Co. took possession of the Coin Bond property in January and started work on an 1,800-foot crosscut tunnel to prospect the porphyry dyke on the north end of the Gold Hill group. The Idaho Gold Dredging Corporation worked property on Grimes Creek between Centerville and Pioneerville and treated nearly 294,000 cubic yards of gravel in a dredge which has a capacity of 2,000 cubic yards a day. The plant was worked 262 days and recovered gold valued at about $37,000. As in recent years, the largest hydraulic operations were those of the Boise Placer Co. at Idaho City. The company treated about 150,000 yards of gravel and recovered gold valued at about $9,000. The giants were operated 57 days, and 90 days were spent in preparing and equipping the property for next year's run. Placer gold was also recovered at the Wine Cup property at Pioneerville, from the Gold Hill tailings at Quartzburg, at the Black Hawk claim at Centerville, and at the Swede Gulch property at Pioneerville.

BONNER COUNTY

The value of the production of metals in Bonner County increased $31,516 in 1929, due chiefly to the increased shipments of silver-lead ore from the Elsie K. property worked by the Hope Mining Co. The largest producer in the county was the Whitedelf Mining & Development Co., operating a lead property near Clark Fork; its production in 1929, however, was slightly less than that in 1928. A bulletin[5] giving the geology of the region near Clark Fork was issued early in 1930.

Lakeview district.—Virtually no development was done at the Minerva property in 1929, but lead-zinc ore was shipped to the Sweeny and Hercules custom mills for flotation tests. The Hewer mine near Lakeview was worked the entire year by the Idaho Lakeview Mines Co.; about 513 feet of sinking and 1,620 feet of lateral work were done, which opened much new ore. The 100-ton flotation-concentration plant on the property was idle.

Pend d'Oreille district.—Six lode mines in the Pend d'Oreille district produced 11,834 tons of ore, yielding $94 in gold, 90,224 ounces of silver, 993 pounds of copper, and 1,725,085 pounds of lead, valued in all at $157,038, or $13.27 in metals a ton. Most of the output (10,146 tons) was silver-lead ore of milling grade; the remainder was first-class ore smelted, nearly all of which was silver-lead ore. The largest production was that of the Whitedelf Mining & Development Co., which completed the construction of a 75-ton flotation mill. The mill was put into operation in August, after which about 9,500 tons of lead ore were treated. Crude lead ore and high-grade lead concentrates were shipped to East Helena, Mont., and Bradley, Idaho. In addition to the work on the new mill the company did 600 feet of drifting on two levels of the mine. At the neighboring property, the Elsie K. mine, the Hope Mining Co. developed considerable lead ore by drifting and tunneling aggregating 1,400 feet. More than 600 tons of first-class lead ore was shipped to East Helena, Mont., for smelting, and some silver-lead ore was shipped to Wallace, Idaho, for treatment by flotation. One car of crude lead ore and two cars of rich silver-lead concentrates were shipped from the Lawrence property, about 2 miles west of Clark Fork. The 50-ton concentrator was operated only 10 days and about 200 feet of development was done in the mine. Small shipments of siliceous silver ore were made from the Catherine and Talache properties.

BONNEVILLE COUNTY

Mount Pisgah district.—Bench gravel was treated for a short time at the American placer near Gray, and the output consisted of 10 ounces of exceptionally fine gold.

BOUNDARY COUNTY

Since the closing of the mill of the Idaho Continental Co. in February, 1928, the production of metals in Boundary County has been relatively unimportant.

Moyie Yahk district (*Bonners Ferry*).—The North Idaho Metals & Mining Co. operated a group of claims on Boulder Creek near Leonia and shipped one small lot of silver-lead ore to Bradley. The company worked five months driving a 370-foot crosscut and also did considerable work in constructing roads and bridges. Development was also done at several properties near Leonia and Bonners Ferry, including the Idamont, Lead Consolidated, and Gold Shaft mines.

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[5] Anderson, Alfred L., Geology and Ore Deposits of the Clark Fork District, Idaho: Idaho Bur. of Mines and Geol. Bull. 12, March, 1930.

Port Hill district (*Klockmann*).—The Idaho Continental mine, a large producer of silver-lead ore from 1915 to 1926, was idle in 1929. For 12 years ending in 1926 it was the largest producer of silver and lead north of the Coeur d'Alene region.

BUTTE COUNTY

The production of metals in Butte County in 1929 was valued at $266,451, an increase of $121,419 over 1928, due entirely to the large increase in the shipments of lead concentrates by the Wilbert Mining Co. (Ltd.). The mine ranked fourteenth as a producer of lead in Idaho in 1929; excluding the Coeur d'Alene region in Shoshone County, it was the second largest producer of lead in Idaho. A bulletin[6] describing the Craters of the Moon National Monument was published in 1928.

Antelope (*Lead Belt*) *district*.—One car of silver-lead ore from the Lead Belt property was shipped from Arco, a station on the Oregon Short Line Railroad.

Dome district.—The Wilbert mine, 23 miles north of Arco, was actively worked during the year. A 60-ton gravity-concentration mill, equipped with jigs and tables, treated more than 14,000 tons of lead ore, resulting in the shipment of more than 3,000 tons of rich silver-lead concentrates. The output of the property was nearly double that of 1928, and 700 feet of development was done. In April a 17-mile transmission line was constructed to supply the property with electric power, and the mine and mill plants were converted from gas-driven to electrically-driven units.

Lava Creek district.—About 400 feet of general development was done at the Silver Bell property, and 175 feet of shaft sinking was completed at the St. Louis mine, but no ore was shipped from either property. In the past several cars of silver-lead ore, some of which was exceptionally rich in silver, were shipped from the St. Louis property. Development of the property of the Horn Silver Consolidated Mines Co. was reported to have disclosed a considerable quantity of lead ore of milling grade, and the company is planning the construction of a small concentration plant. The geology and ore deposits of the district were reviewed by the Idaho Bureau of Mines and Geology[7] in 1929.

CAMAS COUNTY

Gold Belt district.—A test lot of gold ore was shipped from the Yellow Jacket group by way of Blaine, a station on the Oregon Short Line Railroad.

Little Smoky district.—The Perseverance Mining Co. worked the Five Points mine, 12 miles north of Fairfield, and several small lots of gold ore were shipped to Midvale, Utah, for smelting.

CLARK COUNTY

Birch Creek district.—The Beaver Head Mining Co. shipped a small lot of oxidized lead ore from the Scott mine, 65 miles northwest of Idaho Falls.

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[6] Stearns, H. T., Craters of the Moon National Monument, Idaho: Idaho Bur. of Mines and Geol. Bull. 13, 1928.

[7] Anderson, Alfred L., Geology and Ore Deposits of the Lava Creek District, Idaho: Idaho Bur. of Mines and Geol. Pamphlet 32, August, 1929.

CLEARWATER COUNTY

The geology and mineral resources of the region about Orofino were reviewed by the Idaho Bureau of Mines and Geology[8] in 1930.

Moose Creek district.—The Poor Man placer on Independence Creek near the old town of Moose City was worked from April to August. Most of the output was shipped to the assay office at Helena, Mont., but part of it was sold locally in the form of nuggets.

Pierce district.—The output of the Pierce district consisted of three small lots of placer gold from the Huckleberry & Homestake, Mox Mox, and Newman claims. The Pierce district, formerly a large producer of gold, is reached by a branch line of the Northern Pacific Railway from Lewiston.

Ruby Creek district.—The Ruby Creek Mining Co., which owns 20 claims on Ruby Creek, constructed a mill building for a 150-ton flotation plant to treat silver-lead-zinc ore. The shipping point of the property is Neva, a station on the Chicago, Milwaukee, St. Paul & Pacific Railway, north of Dent.

CUSTER COUNTY

The value of the production of metals in Custer County increased from $355,673 in 1928 to $977,999 in 1929, the largest value recorded for the county since 1918; the county ranked second in value of production of metals in Idaho in 1929, following Shoshone County. The output of all metals except zinc increased considerably. The largest producers in the county were the Mackay Metals (Inc.) and the Livingston Mines Corporation. The Mackay Metals (Inc.) was the largest producer of copper in Idaho in 1929, ranked third as a producer of gold, and was also a large producer of silver. The Livingston Mines Corporation greatly increased its shipments of lead concentrates but made no lead-zinc middlings. Excluding the Coeur d'Alene region the company ranked first as a producer of lead and second as a producer of silver in Idaho in 1929.

Alder Creek district (*Mackay*).—Three lode mines in theAlder Creek district produced 66,599 tons of ore, yielding $47,187 in gold, 61,195 ounces of silver, 2,824,445 pounds of copper, and 9,383 pounds of lead, valued in all at $577,497, or $8.67 in metals a ton. The output consisted of 15,812 tons of first-class smelting ore and 50,787 tons of milling ore, which was reduced to 4,273 tons of concentrates. The largest producer in 1929 was the Empire mine of the Mackey Metals (Inc.), which was by far the largest producer of copper in Idaho; it ranked third as a producer of gold and was also a large producer of silver. The mine and the 220-ton flotation mill were operated throughout the year. The property is extensively developed and 1,500 feet of additional work was done in 1929. A Nordberg steam-driven compressor was added to the surface plant, new equipment was installed at the mine, and the 1,000-foot level was opened for production. The ore contains chiefly chalcopyrite, cuprite, and chrysocolla, and work on the 1,000-foot level was said to have increased the ore reserves considerably. Nearly 15,800 tons of first-class copper ore was shipped to Utah for smelting, and the flotation mill treated 51,000 tons of sulphide ore, which was reduced to 4,273 tons of copper concentrates.

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[8] Anderson, Alfred L., The Geology and Mineral Resources of the Region about Orofino, Idaho: Idaho Bur. of Mines and Geol. Pamphlet 34, June, 1930.

The copper output was more than five times that of 1928, during which year the mine was idle most of the time. One lot of silver-lead ore was shipped from the White Knob property, and two lots of copper ore and lead ore were marketed from the Grand Prize mine, 1 mile south of White Knob. A pamphlet[9] describing the geology and ore deposits of this district was published in 1930.

Bay Horse district.—The Ramshorn property near Clayton, formerly a large silver producer, was worked by lessees. Three cars of first-class copper-lead ore containing a total of 28,440 ounces of silver were shipped to the lead smelter at Midvale, Utah. One car of oxidized lead ore was shipped from the Rob Roy property.

Boulder district.—The property of the Livingston Mines Corporation near Railroad Ridge, 63 miles northwest of Mackay, was worked throughout the year. The 300-ton concentration mill, equipped for both gravity and flotation, treated 25,577 tons of lead ore and about 4,300 tons of silver-lead concentrates was marketed. No effort was made in 1929 to save separate zinc concentrates or middlings. The mine is opened by 19,715 feet of drifts and tunnels and by 3,823 feet of raises; in 1929 the company did development aggregating 2,000 feet of crosscuts and drifts, as well as a large amount of stoping. Development on shafts and tunnels was also done at the Crater property near by, and a small lot of gold was recovered from the Outlaw placer claim.

Seafoam district.—The Greyhound property north of Stanley was worked a short time in 1929, and two cars of rich silver ore were shipped to Garfield, Utah, from Ketchum, a station on the Oregon Short Line Railroad.

Stanley Basin district.—Small lots of placer gold were recovered from claims in the vicinity of Stanley; the chief producer was the Jose Gulch placer. Placer property 12 miles east of Obsidian was being developed by the Pig Tail Placer (Inc.).

Yankee Fork district.—Three lode mines and one placer in the Yankee Fork district produced 16 tons of ore, $1,391 in gold, 3,522 ounces of silver, and 407 pounds of copper, valued in all at $3,341. A little placer gold was recovered from the Rough Creek placer, a glacial deposit near Salmon River. A car of rich silver ore containing considerable gold was shipped from the McFadden property by lessees. The Franklin and Casto claims near Stanley produced a small lot of rich gold ore, which was shipped to a smelter, and a little gold ore was treated locally by amalgamation. Some development was done at the Why Not property on Estes Mountain and at the Kingfisher group of the Aztec Mining & Milling Co.

ELMORE COUNTY

The value of the production of metals in Elmore County decreased from $94,223 in 1928 to $811 in 1929, due entirely to the inactivity of the South Park dredge at Featherville.

Bear Creek district (*Featherville*).—The output of the Bear Creek district was negligible in 1929, as the operations of the dredge of the South Park Dredging Co. were suspended in June, 1928. The company was a large producer of gold from 1922 to 1928 and produced gold valued at more than $200,000 in 1923; it was the largest producer of gold in Idaho in 1924, 1926, and 1927, and the second largest producer in 1923 and 1925. A little gold was recovered as the result of a clean-up at old milling plants in the district.

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[9] Ross, Clyde P., Geology and Ore Deposits of the Seafoam, Alder Creek, Little Smoky, and Willow Creek Mining Districts, Custer and Camas Counties, Idaho: Idaho Bur. of Mines and Geol. Pamphlet 33, March, 1930.

Middle Boise district (*Atlanta*).—One lot of gold ore from the Winner group, near Atlanta, was treated in a small Ellis ball mill equipped with an amalgamation plate. There was also a clean up of gold-bearing material from an old mill site. At the General Pettit property and the Monarch group, now worked by the St. Joseph Lead Co., nearly 650 feet of work was done in tunneling and cross cutting. These mines were large producers of gold bullion from 1908 to 1910 and from 1915 to 1917.

Twin Springs district.—A small quantity of placer gold was recovered from the Sunflower claim on the Boise River, southeast of Idaho City.

GEM COUNTY

Squaw Creek district.—The American Mines Development Co. worked the Old Liberty group on Squaw Creek, but no products were marketed. The company is driving a 1,000-foot adit to intersect at depth a vein opened in surface workings. Five hundred feet of this work was done late in 1929 and early in 1930.

West View district (*Emmett, Eagle*).—Considerable prospecting was done at the Lincoln mine at Pearl, and several hundred tons of gold ore was treated in the 100-ton flotation mill. The mine development, however, was disappointing, and all work was discontinued in October. A small lot of oxidized lead ore containing considerable gold and silver was shipped from the Premier mine on North Willow Creek.

IDAHO COUNTY

The production of metals in Idaho County was valued at $48,699 in 1929, an increase of $14,654 over 1928 but a small output compared with that of 20 years ago. The Unity Gold Mines Co. at Warren and the Lone Pine mine at Golden were the largest producers in the county in 1929; the output of gold ore from the Unity mine was nearly double that of 1928. The mines of Elk City, Ten Mile, Buffalo Hump, and Orogrande districts have needed transportation facilities for many years. The nearest railroad stations are Grangeville and Stites. A section of the proposed highway along the South Fork of the Clearwater River was completed as far as Huston, near Newsome, and the old road to Stites is no longer used for mail and general traffic.

Butts Creek district.—A little gold was recovered from placer claims on Salmon river.

Camp Howard district.—The Seelridge Gold Mining Co. worked six months preparing to operate placer property near White Bird on the Salmon River. One drag-line excavator and two Wilfley tables were installed, but no gravel was treated in 1929.

Dixie district.—A little placer gold was recovered from the Capital property on the north side of the Salmon River, 15 miles south of Dixie.

Elk City district.—Three small placers in the Elk City district produced gold and silver valued at $286. Work was done at the

Relief property on Relief Creek, at the Deadwood placer 5 miles south of Elk City, and at the Red Horse placer on Red Horse Creek. Considerable prospecting by churn drills was said to have been done by the "96" Mining Co. on placer ground on Elk Creek, Red River, and American River, with a view to installing a dredge.

Marshall Lake district (*McCall*).—At the Leadville property near Burgdorf a little gold ore was treated by amalgamation in a 2-stamp Hammond mill, and a little rich gold ore from the Cuban property was treated in a hand mortar. Tunnel work was continued at the Holte property, formerly a large producer of gold, by the Golden Anchor Mining Co. The Sherman Howe Mining Co. made large expenditures in the installation of machinery and the construction of camp buildings.

Meadow Creek (*Green Mountain*) *district*.—The Copper King group near Red River Hot Springs was being prospected by the Bunker Hill & Sullivan Mining & Concentrating Co. of Kellogg.

Simpson district.—Small lots of placer gold were recovered from the eastern bank of the Salmon River particularly at the Hawk group and at the Gardner Bar property near White Bird. The Salmon River Development Co. was reported to have constructed a large plant equipped with elevating, screening, and sluicing equipment, but no output was reported, and operations were suspended in August.

Ten Mile district (*Golden*).—One placer and three lode mines in the Ten Mile district produced 756 tons of ore, $19,135 in gold, and 363 ounces of silver, valued together at $19,328; the ore had an average value of $24.13 in metals a ton. Most of the output was gold ore from the Lone Pine mine near Golden which was treated in a 2-stamp amalgamation mill. The mill was operated several months. At the mine 350 feet of development was done in the tunnel as well as construction work on roads and trails. A new vein of ore 18 inches wide was found parallel to the original vein and 20 feet from it. Gold bullion valued at about $4,000 was recovered in a 15-ton amalgamation mill at the Mackey mine of the Buffalo-Idaho Mining Co. (Inc.). Gold bullion was also recovered at the New York property, operated by the Central Idaho Gold Mines (Inc.). Placer gold was, as usual, recovered from the Moose Creek placer, 6 miles from Golden on the South Fork of the Clearwater River.

Warren district.—Two placers and one lode mine in the Warren district produced 2,113 tons of ore, $26,290 in gold, 2,886 ounces of silver, 75 pounds of copper, and 584 pounds of lead, valued in all at $27,879; the ore had an average value of $11.99 in metals a ton. Most of the output was gold ore from the Little Giant property of the Unity Gold Mines Co., which is 47 miles northeast of the nearest railroad station at McCall. Development in 1929 consisted of 509 feet of raising and 433 feet of drifting. Bullion was deposited at the Boise assay office and one car of rich gold concentrates was shipped to Midvale, Utah, for smelting. Most of the gold is free, but it is closely associated with small quantities of galena and sphalerite. The mine ranked fifth as a producer of gold in Idaho in 1929, and the output of bullion was considerably more than in 1928. The gold and silver contained in placer bullion was valued at $2,551 and came chiefly from the Golden Rule property on Grouse Creek, 6 miles east of Burgdorf near the Secesh River.

KOOTENAI COUNTY

No ore was shipped from prospects in Kootenai County in 1929 as most of the companies did only annual assessment work. Development was continued at the Blue Bird, Royal, Silver Tip, and Wolf Lodge properties.

LATAH COUNTY

Hoodoo district (*Harvard*).—The output of the Hoodoo district near Harvard consisted of two cars of sulphide copper ore shipped from the Easton property and a little placer gold recovered from stream gravel at the Annie placer on the North Fork of the Palouse River, east of Harvard.

LEMHI COUNTY

The value of the metals produced in Lemhi County in 1929 was $223,017, the lowest value recorded since 1921. The large decrease in the output of silver and lead from the Pittsburg-Idaho property offset the increase in the output of copper from the Pope-Shenon mine, the largest producer in the county.

Eldorado district (*Salmon*).—The Harmony Mines Co., working property 8 miles northeast of Baker, treated about 4,800 tons of copper ore in a 150-ton flotation plant equipped for coarse crushing, ball-mill grinding, flotation, and filtration. The mine was operated continuously, and the mill ran four months. The property is opened by winzes and raises from an adit tunnel, and 620 feet of work was done in sinking, drifting, and raising in 1929. In addition to this work an 8-mile transmission line was constructed, an electric generator installed, and new equipment added to the mill. The ore consists chiefly of chalcopyrite and pyrite. Articles[10] describing the mining and milling methods used at the Harmony property were published in 1930 by the United States Bureau of Mines.

Eureka district.—Two placers and two lode mines in the Eureka district produced 20,001 tons of ore, $1,769 in gold, 1,925 ounces of silver, and 697,614 pounds of copper, valued in all at $125,575; the ore had an average value of $6.21 in metals a ton. The placer output was valued at $1,394. The largest producer in the district was the Pope-Shenon mine, 9 miles south of Salmon, which was worked by the Winder-Stillman Consolidated. The company operated a 150-ton flotation plant on copper ore and shipped more than 1,000 tons of concentrates to the copper smelter near Tooele, Utah. Improvements were made in the mill during 1929, and an additional ball mill was purchased. A new compressor was installed, and about 1,000 feet of development, which was said to have opened much new ore, was done in the mine. The remainder of the output of the district, aside from a little bullion recovered by cleaning up an old mill and some placer gold produced by prospectors on Salmon River, consisted of gold recovered from the McNutt placer on Moose Creek 18 miles northwest of Salmon. The property was operated from May to July by hydraulic and sluicing methods.

Gibbonsville district.—A small quantity of old material containing chiefly gold and lead was cleaned up from the old mill of the Rescue gold mine near Gibbonsville and shipped to the smelter at Midvale, Utah. The Sheep Creek placers on Sheep Creek were operated four months during the summer, and a little gold was shipped to the assay office at Boise.

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[10] Gardner, R. Duncan, Mining Practice at Harmony Mines Co., Baker, Idaho: Inf. Circ. 6240, Bureau of Mines, March, 1930, 8 pp.; Milling Methods and Costs at the Harmony Mines, Baker, Idaho: Inf. Circ. 6285, Bureau of Mines, June, 1930, 18 pp.

Junction district (*Leadore*).—Five lode mines in the Junction district produced 73 tons of ore, yielding $7 in gold, 996 ounces of silver, 588 pounds of copper, and 33,859 pounds of lead, valued in all at $2,774, or $38 in metals a ton. Most of the output was first-class sulphide lead ore shipped to a smelter from the Kimmel & Sunset and Buckhorn properties. The remainder consisted of test lots of lead ore, copper ore, and silver ore from the Dirigo, Copper Carbonate, and Homestake properties. The Continental Standard Mining Co. did considerable development at the Road Agent group 2 miles from Cruik, a station on the Gilmore & Pittsburgh Railroad. The work consisted of sinking a 5 by 7 foot inclined shaft to a depth of 220 feet and crosscutting and drifting a distance of 225 feet.

McDevitt district (*Tendoy*).—The Copper Queen group near Tendoy was worked by the Tendoy Copper Queen Mining Co., which shipped one car of first-class copper ore and several small lots of rich copper concentrates containing considerable gold. Development consisted of 70 feet of drifting.

Mackinaw district (*Leesburg*).—Four placers in the Mackinaw district produced gold valued at $1,944 and 7 ounces of silver, valued together at $1,947. As usual, most of the output came from the Hockensmith placer on Arnett Creek, which was worked from May 1 to October 4. A small output of gold was recovered from the K. G. W., Phelan Creek, and Arnett Creek placers. The Bonanza Placer (Inc.) worked the Leesburg Bonanza property on Napias Creek, Camp Creek, and Rapps Creek, but only construction work was done during the summer. The property is equipped with four hydraulic giants and other machinery for placer work. The Leesburg placers, owned by the Montana Mining & Livestock Co. (Inc.), produced no gold in 1929, but the gravel deposit was tested further and machinery added to the hydraulic plant.

Mineral Hill district.—Lessees of the Clipper-Bullion property at Shoup treated a little gold ore by amalgamation and concentration. Bullion was shipped to the assay office at Boise and a small lot of gold concentrates to East Helena, Mont.

Nicholia district.—The Viola mine, owned by the Beaver Head Lead Mining Co., was operated by lessees who shipped several cars of carbonate lead ore and lead concentrates to Utah for smelting. New mining equipment was installed and some development done at the Ida property or Nicholia group.

Parker Mountain (*Singheiser*) *district.*—A small lot of ore containing considerable gold and silver was shipped from the Pinch Hit property on Parker Mountain.

Pratt Creek district.—No production was reported from the Goldstone property on Pratt Creek, but a hydroelectric power plant was installed during the year, and it was planned to operate the 100-ton flotation mill in 1930 on ore containing chiefly gold and lead.

Spring Mountain district.—A small lot of oxidized lead ore was shipped from the Dividend prospect, and 380 feet of tunneling was done at the Big Windy mine by the Spring Mountain Mining Co.

Texas district (*Gilmore*).—Four lode mines in the Texas district produced 1,376 tons of ore, yielding $1,289 in gold, 9,973 ounces of silver, 2,959 pounds of copper, and 364,303 pounds of lead, valued in all at $30,077, or $21.86 in metals a ton. The output in 1929, which was less than that of any year since 1909, consisted of 876 tons of first-class lead ore and 500 tons of concentrating ore. The Pittsburg-Idaho property of the United Idaho Mining Co. was as usual the largest producer at Gilmore; the output was, however, unusually small, as the power house was wrecked by an explosion which occurred about the middle of the year. No concentrates were shipped after the accident, but about 700 tons of crude ore was marketed during the year. The mine has been a large producer of silver-lead ore since 1904, and in both 1911 and 1912 it produced more than 12,000,000 pounds of lead. The remainder of the district output in 1929 consisted of several lots of silver-lead ore shipped from the Tidal Wave, Latest Out, and Gilmore properties. About 250 feet of work was done in the tunnel and inclined shaft at the Gilmore mine. The Iron Dyke or Mountain Boy property was equipped with a Sullivan compressor, and 300 feet of drifting was done.

Unorganized (*Reno*) *district.*—At the Cabin property about 400 feet of development was done in tunneling and raising, and one car of oxidized lead ore was shipped to Murray, Utah, for smelting.

Yellow Jacket district.—At the Copper Glance group, 100 miles northwest of Mackay, the nearest shipping point, a little development was done, and one car of copper-lead ore was shipped to Utah for smelting. A car of sulphide copper ore containing considerable gold was shipped from the Steen group, 1 mile southwest of the Yellow Jacket mine.

OWYHEE COUNTY

The production of metals in Owyhee County in 1929 was valued at $29,524, an increase of $8,765 over 1928. The increase was due to the work of the new dredge of the American Gold Dredging Corporation near Triangle. From 1863 to 1929 the county yielded $21,741,071 in gold and 24,622,251 ounces of silver, or a value of $40,730,005 for both metals.

Carson or French district (*Silver City*).—One placer and nine lode mines in the Carson district produced 202 tons of ore, $5,643 in gold, and 7,718 ounces of silver, valued together at $9,757; the ore had an average value of $48 in metals a ton. The output consisted of 6 tons of first-class smelting ore, 182 tons of ore of concentrating grade, and 14 tons of ore that was amalgamated. The largest producer in the district was the Neversweat property, operated by lessees who treated about 180 tons of gold ore by a combination of gravity concentration and flotation. As a result of milling operations one small lot of concentrates rich in gold and silver was shipped from Murphy, a station on the Oregon Short Line Railroad, to Utah for marketing. The mill equipment consists of a rod mill, two Wilfley tables, and flotation cells. The remainder of the output of the district consisted of small lots of first-class gold ore and concentrates shipped from the Gold Bug, Alpine, and Lindy properties and gold bullion cleaned up at various mines and mill sites. A large part of the gold and silver in bullion was recovered from clean-up material from an old mill site at Silver City. About 200 feet of drifting was done on the vein of the Village Blacksmith property near Silver City.

Rough Mountain district.—The Gold Bug group, on Summit Flat between Poison Creek and Castle Creek south of Grand View, produced a small lot of placer gold which was sold to the assay office at Boise.

South Mountain district.—Late in the year the Golconda property on South Mountain, a producer in the early days of mining in Idaho, was being operated by the Exploration Co. of California, which made plans for driving a 2,000-foot tunnel to develop ore containing chiefly silver, lead, and zinc.

Steele district.—Gold valued at about $19,000 was recovered from the Meadow Creek property near Triangle, 12 miles south of Silver City. The property is equipped with an electric dredge capable of handling 1,500 cubic yards of material a day. The plant operated from March 10 to October 15 and treated 250,000 yards of gravel.

SHOSHONE COUNTY

COEUR D'ALENE REGION

Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, Idaho, 1928 and 1929, and total, 1884–1929, in terms of recovered metals

Year	Lode mines	Placers	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc	Total value
			Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1928	42	4	[1] 1,949,980	[2] $8,838	8,513,048	1,044,105	278,551,953	57,329,671	$24,792,445
1929	44	2	[1] 1,971,580	[2] 10,556	8,776,726	1,320,700	283,115,336	86,092,294	28,439,351
Total, 1884–1929	------	------	(3)	7,159,085	246,442,376	80,062,211	[4] 4,079,606	748,971,624	700,835,967

[1] Includes old tailings as follows: 1928, 179,529 tons concentrated; 1929, 41,133 tons concentrated and 36 tons sold to a smelter.

[2] Includes placer production as follows: 1928, $1,320 in gold and 11 ounces of silver; 1929, $790 in gold and 3 ounces of silver.

[3] Figures not available.

[4] Short tons.

The value of the production of metals in Shoshone County, which includes the Coeur d'Alene region, was $28,439,351 in 1929, or $3,646,906 more than the value in 1928; the gain was mainly in the output of lead-zinc ore, which increased more than 145,000 tons. The average total value of the ore and old tailings in 1929 was $14.42 in recovered metals a ton, and the value in gold and silver, chiefly silver, was $2.38 a ton. The kinds of ore (largely lead ore and lead-zinc ore with some copper ore and copper-lead ore) and the contents of each kind have been given in preceding tables.

Most of the ore, as well as 41,133 tons of old tailings, was concentrated and produced 321,824 tons of concentrates, yielding on the average $82.95 in metals a ton. Nineteen milling plants, with a combined daily capacity of approximately 7,500 tons, were active during the year. Two of these mills used equipment for gravity concentration and flotation and 17 were flotation mills without gravity equipment. There were large increases in the output of all metals except gold, which increased slightly; the increases in lead and zinc were especially large. A substantial increase in lead from all concentrates made from lead ore and lead-zinc ore offset a large decrease in lead from crude lead ore of smelting grade. The three largest producers of lead and the largest dividend payers in Idaho—the Bunker Hill & Sullivan, Morning, and Hecla mines—are in Shoshone County, at Kellogg, Morning, and Burke. The statement to the county assessor gave $7,691,090 as the net profits of the Coeur d'Alene mines and leases in 1929, an increase from $6,842,499 in 1928. The gross value of the ore and concentrates produced in 1929, as reported by the assessor, was $25,658,061, a large increase as compared with $23,799,205 in 1928 and $23,564,645 in 1927.

For further details regarding the mining industry of Idaho, reference is again made to the annual report of the State mine inspector for 1929 (see p. 364).

Beaver district.—The Tuscumbia Mining Co. (Ltd.) shipped one car of high-grade sulphide lead ore to East Helena, Mont., for smelting. At the Interstate-Callahan property[11] north of Wallace the mine and old concentration plant were idle, and the company confined its efforts to the Galena mine southwest of Wallace, the production of which is given under the Placer Center district. A small crew of men was employed at the Interstate property to do the necessary repair work, and a short crosscut was being run to explore a vein parallel to the Interstate vein which produced much zinc ore in the past. The printed report of the company continues:

> The old Interstate property, located at the head of Nine Mile canyon, 7 miles northeast of Wallace, comprising 1,030 acres, was operated from 1915 to 1923, producing 298,379 dry tons of high-grade zinc and lead concentrates, together with 43,908 tons of crude lead and zinc ore. This property has not been operated since the latter part of 1923, as we were compelled to stop all operations on account of the sudden drop in the zinc market, which has not sufficiently recovered since for us to operate at a profit.

Eagle district (*Murray*).—The Jack Waite Consolidated Mining Co., which owns the Jack Waite group in Idaho and the adjoining Silver King group in Montana, was the only producer in the district in 1929. The mine and the 150-ton flotation mill were worked throughout the year. The company treated about 34,000 tons of lead-zinc ore, which was reduced to more than 4,000 tons of lead concentrates and zinc concentrates. The products were hauled to the terminus of the logging road which connects with the Oregon-Washington Railroad & Navigation Co. at Prichard. Four cars of first-class sulphide lead ore were also mined and shipped to the smelter at Bradley. The property produced lead concentrates containing more than 4,000,000 pounds of lead, and zinc concentrates containing about 600,000 pounds of zinc. The Jack Waite mine produced more than twice as much lead in 1929 as in 1928 and ranked twelfth as a producer of lead in Idaho. The property is at the head of Eagle Creek northeast of Prichard, on the divide between Idaho and Montana, and is developed chiefly by two tunnels, one 1,500 feet long and the other 3,500 feet long. Some of the first-class lead ore was unusually rich, averaging 70 per cent of lead by the carload. In 1929 and preceding years the ore was mined from the Idaho side of the divide, but interesting disclosures have been made on the Montana side and future production will come partly from that State. The property is equipped with a flotation plant, parts of which were assembled from old mills in the region. The plant will require rebuilding and much modern machinery before a satisfactory separation of the galena and sphalerite in the mill feed can be made. A little development was done at the claims of the United States Silver-Lead Mines Co. near the Jack Waite property, and a little testing was done on the placer property of Dunlap & Smith on upper Eagle Creek.

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[11] Callahan Zinc-Lead Co. Ann. Rept. for 1929.

Evolution district.—Four lode mines and one old tailings dump in the Evolution district produced 69,633 tons of ore and 900 tons of old tailings, which yielded $524 in gold, 1,684,846 ounces of silver, 294,590 pounds of copper, 2,145,483 pounds of lead, and 169,047 pounds of zinc, valued in all at $1,096,717, or $15.55 in metals a ton. With the exception of the old tailings and 41 tons of first-class smelting ore the output was all ore of concentrating grade. The output was chiefly that of the Sunshine Mining Co., which operated the Yankee Boy mine on the eastern side of Big Creek. In 1929 the mine and the 350-ton flotation mill were operated regularly, and about 2,900 tons of copper-lead concentrates, exceptionally rich in silver, was shipped to the smelter at Bradley. The property is opened by five tunnels, the longest of which is 3,000 feet, an inclined winze from the tunnel level to the 1,300-foot level, and more than 6,500 feet of drifts and tunnels. About 3,700 feet of development was done in drifts, crosscuts, and shaft sinking in 1929. The No. 5 tunnel (also called the Prize tunnel) was enlarged and straightened, and the inclined winze was raised from the 1,000-foot level to the No. 5 tunnel, thus eliminating the 500-foot vertical winze.

On account of the predominance of silver-bearing tetrahedrite the ore contains much more silver than the average lead ore of the Coeur d'Alene region. All the claims and underground workings of the mine are east of Big Creek, the dividing line between Evolution and Yreka districts. The mill, which is equipped with crusher, ball mills, and Minerals Separation flotation machines, was completely remodeled during the year; it is 2½ miles south of Shont, the loading station of the Oregon-Washington Railroad & Navigation Co. The property ranked second as a producer of silver in the State in 1929, and the company paid dividends amounting to $330,000, raising the total since 1927 to $630,000. According to the figures given to the county assessor the company extracted 62,392 tons of ore, which had a gross value of $884,222. The cost of extraction was $330,387, freight and treatment $73,819, and betterment and repairs $108,140; the net profit was $371,876. In the spring a fire destroyed the hoist house (including the hoist) and the compressor at the Charles Dickens property of the Dickens Consolidated Mines Co.; after repairs were made the 150-ton flotation plant was operated in November and December. Lead concentrates were shipped to East Helena, Mont., and Bradley, Idaho, and the zinc product was treated at the Sullivan zinc plant at Silver King, Idaho. The product is hauled 3 miles to Shont, the nearest railroad siding.

At the Silverado property the Lincoln Mining Co. did 480 feet of work in drifts and crosscuts, and lessees treated about 600 tons of ore in a 50-ton flotation plant. Lead and zinc products were shipped to the Bunker Hill smelter at Bradley and the electrolytic zinc plant at Silver King. The remainder of the district output consisted of one car of lead ore from the Western Union property, where lessees did about 200 feet of development, and of old tailings from the flats of the Coeur d'Alene River which were shipped to the Hercules custom mill at Wallace. No ore was shipped by the Evolution Mining Co., but the company deepened its inclined shaft during the year and did considerable drifting on the 300-foot level. A large quantity of low-grade ore was said to have been opened. The Silver Summit Mining Co. installed a new compressor at the portal of the Silver Summit tunnel and advanced the face about 500 feet. The property is east of the Sunshine mine, and the extension of the Sunshine vein is sought.

Hunter district (*Mullan*).—Six lode mines in the Hunter district produced 681,343 tons of ore, yielding $4,010 in gold, 1,985,064 ounces of silver, 234,685 pounds of copper, 86,013,827 pounds of lead, and 54,048,440 pounds of zinc, valued in all at $10,089,421, or $14.81 in metals a ton. The output from this district in 1929 was more valuable than that from any other district in Idaho. It consisted of 5,169 tons of first-class ore and 676,174 tons of concentrating ore, which was reduced to 121,152 tons of concentrates, compared with 8,372 tons of first-class ore and 549,583 tons of concentrating material in 1928.

The Morning mine of the Federal Mining & Smelting Co. ranked first as a producer of zinc, second as a producer of lead, and fourth as a producer of silver in Idaho in 1929. As in the past, lead ore and concentrates were shipped to East Helena, Mont., and the zinc product to the electrolytic plant at Great Falls or Anaconda, Mont. The mine is opened by a vertical shaft 2,750 feet below the main adit level, by 30,267 feet of drifts, and by a main adit tunnel 10,000 feet long. More than 1,600 feet of development in drifting, crosscutting, and raising was done in 1929, and the vertical shaft was sunk an additional 163 feet. Development on the 3,250 and 3,450 foot levels was said to have been encouraging and work was started in extending the winze below the adit level to the 3,650-foot level.

An article[12] describing mining methods at the Morning mine appeared early in 1930. The flow sheet of the 1,200-ton mill was completely changed in 1927, and the plant has since been run as a selective flotation mill. An article[13] describing the revised milling methods appeared early in 1930. Since these improvements were made the metal content of both the lead concentrates and the zinc concentrates has gradually increased. The company, which also operates mines in Kansas, Missouri, and Oklahoma, paid dividends amounting to $390,039 in 1929, or a total of $24,098,762 to date, and had a surplus of $7,000,312 at the end of the year.

According to the figures given to the county assessor the company extracted from the Morning mine 386,210 tons of ore, which had a gross value of $6,787,205. The cost of extraction was $2,375,899, freight and treatment $2,303,484, and betterment and repairs $29,897; the net profit was $2,077,925. The printed annual report of the company for 1929 gives the following data:

> The earnings of the Morning mine amounted to $1,946,986, an increase of $152,153 over 1928.

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[12] Wethered, C. E., and Coady, Leo J., Mining Methods at the Morning Mine of the Federal Mining & Smelting Co., Mullan, Idaho: Inf. Circ. 6238, Bureau of Mines, February, 1930, 13 pp.

[13] Dalton, M. P., and Price, G. S., Milling Practice at the Morning Mill: Min. Cong. Jour., vol. 16, No. 1, January, 1930, p. 25.

> The ore mined amounted to 380,660 tons, a decrease of 11,009 tons from the 1928 tonnage. The average grade of the ore was: 9.3 per cent of lead, 3.7 ounces of silver per ton, and 6.4 per cent of zinc.
>
> Further improvement was made in the grade of the concentrates. Lead concentrates now assay around 73 per cent of lead and zinc concentrates around 55 per cent of zinc. * * *
>
> Ore reserves at the end of the year were estimated at 1,653,200 tons. This is 214,400 tons less than at the end of 1928. The tonnage mined was 380,660. The areas mined therefore yielded 166,260 tons more than had been estimated. The decrease in reserves is due to the fact that no new levels were opened during the year. Shaft sinking was resumed in November, and the 3,650 level should be reached and the vein be crosscut during 1930. "Possible ore" is not taken into consideration, although there is little doubt that as deeper levels are reached, much additional tonnage will be developed.

From 386,210 tons of ore, including lead-zinc ore milled and first-class lead ore smelted, lead products that contained 1,140,567 ounces of silver and 62,206,000 pounds of lead were made, and zinc concentrates containing 175,646 ounces of silver, 2,200,000 pounds of lead, and 40,176,000 pounds of zinc were shipped. Lessees also produced several hundred tons of ore that contained 72,922 ounces of silver, 2,842,000 pounds of lead, and 52,000 pounds of zinc.

The Gold Hunter Mines (Inc.) worked its mine on a 1-shift basis 10 months of the year and the 500-ton mill on a 2-shift basis the entire year. For two months the mine was closed on account of fire, which destroyed the compressor plant and the air line. The company shipped about 8,000 tons of silver-lead concentrates to the Bunker Hill smelter at Bradley, a decrease of nearly 1,000 tons from the 1928 output. The mine is opened by two vertical shafts, one 1,200 feet deep and the other 400 feet deep, as well as drifts and raises approximating 10 miles; drifting aggregating 300 feet was done in 1929. The mine ranked seventh as a producer of silver in Idaho in 1929 and eighth as a producer of lead. According to the figures given to the county assessor the company extracted 115,522 tons of ore, which had a gross value of $557,601. The cost of extraction was $382,109, freight and treatment $149,001, and betterment and repairs $19,989; the net profit was $6,502.

The Sullivan Mining Co., owner of the Star mine, which is controlled by the Hecla Mining Co. and the Bunker Hill & Sullivan Mining & Concentrating Co., shipped about 114,000 tons of lead-zinc ore to the South mill of the Bunker Hill & Sullivan Mining & Concentrating Co. at Kellogg, where it was separated by flotation into lead concentrates, which were smelted at Bradley, and zinc concentrates, which were shipped to the electrolytic plant of the Sullivan Mining Co. at Silver King. The Star mine, which resumed mining in February, was to a large extent responsible for the record output of zinc in Idaho in 1929. The mine is developed by a 10,000-foot crosscut from the 2,000-foot level of the Hecla mine, and 2,903 feet of crosscutting, drifting, and raising were done in 1929. The property ranked second as a producer of zinc and sixth as a producer of lead in Idaho in 1929. The following paragraphs are taken from the report of the Hecla Mining Co. for 1929:

> The Star mine at Burke, Idaho, and the electrolytic zinc reduction plant at Silver King, owned and operated by the Sullivan Mining Co. in which the Bunker Hill & Sullivan Mining & Concentrating Co. is an equal holder with the Hecla Mining Co., were operated at maximum capacity throughout the year. The Star mine produced 114,035 tons of mine-run ore from which were recovered 8,873,708 pounds of lead, 15,455,002 pounds of zinc, and 123,593 ounces of silver. * * *

> Development work at the Star mine has proceeded during the year without interruption. The principal feature of this work is a vertical raise in the footwall commencing on what we call the 4,000-foot level of the Star—equal in depth to the 2,000-foot of the Hecla mine with which it is connected. This raise has for its objective a level known as the Moffitt tunnel 2,800 feet higher. Levels have been opened at 3,700 feet, and at 200-foot intervals thereafter. Five of these levels have been developed to the property line on the easterly end where it meets the westerly end of the development on the Morning vein of the Federal Mining & Smelting Co. A sixth level has 50 per cent of the development finished. Three other levels have been passed in the advance made by the raise, only enough work being done at each station to permit operations to be resumed at our convenience without interfering with any work we desire to carry on in the raise or its connections. The raise is within 13 feet of the position of the tenth level and about 900 feet from its objective.

The Golconda Lead Mines operated its mine and 200-ton differential flotation plant the entire year; the plant treated about 65,500 tons of lead-zinc ore, which was separated into lead concentrates and zinc concentrates. The mine is opened by the 5,000-foot Mayflower tunnel, an 800-foot inclined raise and a 400-foot vertical winze, both from the tunnel level, and by 3,000 feet of drifts. In 1929 the company did considerable work in drifting and tunneling, and the winze was sunk an additional 600 feet. The property ranked fifth as a producer of zinc and ninth as a producer of silver and lead in Idaho in 1929, and the company paid its initial dividend, amounting to $80,000. The mine contributed to the general increase in the output of lead and zinc in Idaho by increasing its lead output more than 4,000,000 pounds and its zinc output about 3,600,000 pounds. According to the figures given to the county assessor the company extracted 65,969 tons of ore, which had a gross value of $941,215. The cost of extraction was $315,849, freight and treatment $413,160, and betterment and repairs $49,204; the net profit was $163,002.

A small lot of sulphide copper ore was shipped by lessees from the Silver Cliff mine near Lookout, Mont. No ore was shipped by the Mutual Mines Development Co., but development during the year included the sinking of a 150-foot winze 1,800 feet from the portal of the main operating tunnel of its Deep Wonder property. The Independence Lead Mines Co., operating the Independence and American Commander groups adjoining the Morning mine, did considerable exploration in the No. 4 tunnel and reported a strike of silver-lead ore. The Inspiration Lead Co. (Inc.), operating the Moe and Troy groups, installed a complete surface plant and started a new shaft. The Atlas Mining Co., operating the Atlas group near Mullan, did about 2,400 feet of work in extending the Carbonate Hill drift, which starts at a point 5,000 feet from the portal of the Atlas tunnel. The work was said to have opened the ore zone which had been proved on the upper levels of the mine.

Lelande district (*Burke, Mace, Frisco*).—Five lode mines and three old tailings dumps in the Lelande district produced 360,072 tons of ore and old tailings, which yielded $611 in gold, 1,966,556 ounces of silver, 299,516 pounds of copper, 66,972,039 pounds of lead, and 7,967,844 pounds of zinc, valued in all at $5,846,617, or $16.24 in metals a ton. The output consisted of 19,048 tons of first-class ore and 325,064 tons of concentrating ore, which, with 15,960 tons of old tailings, was reduced to 56,601 tons of concentrates.

The Hecla Mining Co. at Burke, which shipped first-class lead ore and lead concentrates to the Bunker Hill smelter at Bradley and zinc concentrates to the electrolytic plant of the Sullivan Mining Co. at Silver King, was the largest producer in the district. The mine is opened by a 2,800-foot vertical shaft and various drifts, and 6,025 feet of development was done in 1929. About 2,176,047 tons of ore is said to be in reserve. An article[14] describing the mining methods at the property was published in 1930. The 750-ton concentration plant at Gem was operated regularly, as well as the flotation plant for the re-treatment of jig tailings. Changes made at the mill during the year included the removal of the tables and the installation of additional flotation equipment. The company ranked third as a producer of lead and silver in Idaho in 1929. The dividend rate was increased in 1929, the company having paid $900,000 as against $700,000 in 1928; the total dividends paid to date amount to $18,705,000.

Of the ore mined, 235,887 tons was milled at Gem in the company's 750-ton mill equipped for gravity and flotation, making 39,123 tons of concentrates, which, with 18,704 tons of crude ore and 903 tons of lessees' ore, contained 1,668,069 ounces of silver, 58,943,511 pounds of lead, and 1,386,707 pounds of zinc. The published reports of the company state that the output of the Hecla mine for 26 years was 902,648 tons of crude ore and concentrates, containing 25,462,024 ounces of silver, 914,597,122 pounds of lead, and 2,381,288 pounds of zinc.

According to the figures given to the county assessor 311,099 tons of ore and waste were extracted in 1929, which had a gross value of $4,525,857. The cost of extraction was $1,347,247, freight and treatment $940,140, and betterment and repairs $359,172; the net profit was published as $1,879,298. After paying $1,482,619 for various expenses and deducting $123,503 for depreciation, the company paid $224,484 in taxes and $900,000 in dividends. The net receipts amounted to $979,478, which, added to the surplus of 1928, makes a surplus of $5,635,085 at the end of 1929. The new hoisting plant, which is said to be the largest in the Coeur d'Alene region, was placed in operation late in 1929. It is designed to hoist 2,000 tons of ore in 9 hours from the 3,500-foot level, and by reducing the load an ultimate depth of 4,500 feet may be reached. It will serve the Hecla and Star mines and has been described in the Engineering and Mining Journal[15] and in the report of the mine inspector of Idaho.[16]

The Hercules Mining Co. continued to develop several groups under its control, including the Ambergris, Maher-Hearn, Honolulu, and Roanoke properties, and completed the reconstruction of its 800-ton custom flotation plant at Wallace. In 1929 the plant treated 195,300 tons of ore, chiefly from the Tamarack & Custer, Sherman, Dayrock, and Humming Bird properties, which are under the control of the Day interests. The flow sheet and a detailed description of the plant were given in the report of the mine inspector of Idaho. It consists of the usual crushing and grinding machinery and flotation machines of both the Fahrenwald and Minerals Separation type. The Sherman Lead Co. operated its property the entire year and shipped more than 49,000 tons of lead ore to the Hercules custom mill. The property ranked seventh as a producer of lead in Idaho in 1929 and eleventh as a producer of silver. The mine is opened by several tunnels, the longest of which is 5,660 feet. In 1929 nearly 5,700 feet of work was done in drifting, raising, and crosscutting. According to a statement given to the county assessor the company extracted 49,624 tons of ore, which had a gross value of $581,027. The cost of extraction was $252,653, freight and treatment $227,163, and betterment and repairs $3,406; the net profit was $97,805. The Humming Bird Mining Co., operated under the control of the Hercules Mining Co., shipped about 5,700 tons of lead-zinc ore to the Hercules custom mill, where it was separated into lead concentrates and zinc concentrates. The production of the property in 1929 was much less than it was in 1928. According to a statement given to the county assessor the company extracted 5,771 tons of ore, which had a gross value of $76,607. The cost of extraction was $8,072 and freight and treatment $34,439, leaving a net profit of $34,096.

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[14] Foreman, Charles H., Mining Methods and Costs at the Hecla and Star Mines, Burke, Idaho: Inf. Circ. 6232, Bureau of Mines, February, 1930, 21 pp.

[15] Engineering and Mining Journal, Hecla's New Hoist: Vol. 128, Oct. 26, 1929, p. 674.

[16] Stevenson, A. C., New Hoists of Hecla Mining Co.: Thirty-first Annual Report of the Mining Industry of Idaho, for 1929.

At the Frisco group of the Federal Mining & Smelting Co. a 75-ton flotation plant was operated by the Hull Leasing Co., which shipped about 1,500 tons of lead concentrates to East Helena, Mont., and 3,900 tons of zinc concentrates to Great Falls, Mont. The mine ranked seventh as a producer of zinc in Idaho in 1929 and was also a large producer of lead. According to the statement to the county assessor the gross value of the output was $347,672, the cost of extraction $169,636, and freight and treatment $147,552, leaving a net profit of $30,484. The Mace mine of the Federal Mining & Smelting Co. produced 608 tons of ore, most of which was milled at the custom plant at Butte, Mont., where it was separated into lead concentrates and lead-zinc concentrates. One car of first-class sulphide lead ore was shipped to East Helena, Mont., for smelting. No development was done in 1929, and the output consisted of ore from old stopes shipped by lessees. The remainder of the district output consisted of nearly 16,000 tons of old lead-zinc tailings recovered from Canyon Creek and shipped to the Hercules custom mill. The material contained about 10 per cent of zinc, 3 per cent of lead, and 3 ounces of silver to the ton. Although no ore was treated or marketed considerable development was done by the following companies: The Alameda Mining Co. on the Alameda property on Nine Mile Creek; the Hecla Extension Mining Co. on the Anchor group near the Hecla mine; the Ajax Mining Co. on the Ajax group near Burke; and the Ambergris Consolidated Mining Co. on the Ambergris, Guelph, and Honolulu groups, also near Burke.

Placer Center district (*Sunset*).—Five lode mines and two tailings dumps in the Placer Center district produced 144,039 tons of ore and old tailings, yielding $1,426 in gold, 551,497 ounces of silver, 196,142 pounds of copper, 17,158,636 pounds of lead, and 7,309,707 pounds of zinc, valued in all at $1,893,329, or $13.14 in metals a ton. The output consisted of 5 tons of first-class lead ore and 36 tons of old tailings shipped to a smelter and 143,898 tons of concentrating ore, which, with 100 tons of old tailings, was reduced to 23,942 tons of concentrates.

As in recent years, the Tamarack & Custer property was the largest producer in the district in 1929. The 400-ton concentration plant at

Frisco was idle throughout the year, but nearly 84,000 tons of lead-zinc ore was shipped to the custom flotation mill of the Hercules Mining Co. The mine was operated 11 months of the year, and nearly 3,600 feet of work was done, chiefly in drifting and crosscutting. No printed statements were issued giving details of operations in 1929, but new ore was reported to have been opened from the new adit level, the former outlet of the Mammoth mine. All operations at the mouth of the No. 6 tunnel near the old camp of Sunset, reached from Nine Mile Canyon, were abandoned, and subsequent work was conducted from the No. 7 tunnel, which has its portal in Canyon Creek. The mine ranked fourth as a producer of zinc in Idaho in 1929, fifth as a producer of lead, and eighth as a producer of silver. According to the figures given to the county assessor the company extracted 83,922 tons of ore, which had a gross value of $1,002,265. The cost of extraction was $535,185, freight and treatment $459,664, and betterment and repairs $16,674; the net loss was $9,258.

The Dayrock Mining Co. worked its property the entire year and shipped more than 37,000 tons of lead ore to the Hercules custom plant, where lead concentrates were made. About 3,000 feet of development was done in 1929 in drifting, raising, and crosscutting. A new compressor and other surface equipment were installed and preparations were made to sink a 300-foot winze. The property was the largest producer of silver in the Placer Center district in 1929 and ranked second in the production of lead; it ranked sixth as a producer of silver and tenth as a producer of lead in the State, and the company paid an initial dividend amounting to $203,076. According to the figures given to the county assessor, the company extracted 37,254 tons of ore, which had a gross value of $554,720. The cost of extraction was $162,977, freight and treatment $186,699, and betterment and repairs $20,656; the net profit was $184,388.

The Callahan Zinc-Lead Co. worked its Galena mine continuously and treated more than 21,000 tons of lead ore in the 150-ton flotation mill. The output of lead and silver, however, was much less in 1929 than in 1928. Most of the ore came from development done on the new South vein, which is parallel to and 300 feet south of the Galena vein; it was discovered by diamond drilling in 1928. More than 1,800 feet of work in crosscuts and drifts was done in opening the South vein on the 600 and 800 foot levels, and a large quantity of milling ore was said to have been blocked out. Where the vein was crosscut 8 feet of ore averaged 9.4 per cent of lead and 6.3 ounces of silver to the ton. According to the figures given to the county assessor 21,201 tons of ore was extracted, which had a gross value of $98,799. The cost of extraction was $131,795 and the net loss was $32,996. The printed report of the Callahan Zinc-Lead Co. gives the following paragraphs:

> This property consists of 99 lode mining claims, or approximately 1,620 acres, starting at the city limits of Wallace, Idaho, and extending westerly about two and one-half miles. * * *
>
> Our mill is a complete 20-cell Minerals Separation flotation unit, doing very efficient work. * * * With an additional ball mill and classifier it will treat approximately 400 tons per day, as the balance of the mill is equipped to handle that additional tonnage. The mill is so arranged that a total of five men can operate at full capacity working three 8-hour shifts.
>
> A large amount of the exploration and development work was done prior to building the mill, which was put in operation in October, 1926, and since then

> to the present date approximately 127,454 wet tons of ore have been mined and milled, producing approximately 11,077 dry tons of high-grade lead concentrates. * * *
>
> About 900 feet to the west of the South vein crosscut we have a working winze, sunk to a depth of 1,000 feet below the 600 level, which makes it possible to develop the South vein ore body to a depth of 1,000 feet below the 600 level. The winze is fully equipped with heavy duty shaft equipment, handling a two and one-half ton skip. All stations have been cut at 200-foot intervals.
>
> On the 800 winze level, or 200 feet below the 600, a crosscut was driven southeast for a distance of 800 feet, intersecting the South vein close to the west end of the ore on the 600 level above.

Lessees operated the Rex mine of the Delaware Mines Corporation and shipped a few hundred tons of lead-zinc ore to the Hercules custom mill at Wallace. The company did considerable prospecting of the Rex and Patuxent veins through the Red Monarch tunnel, which was said to have been driven 1,000 feet after the new compressor was installed. Lessees also shipped nearly 1,000 tons of lead-zinc ore from old stopes of the Success mine, and old tailings containing silver and lead were recovered from Nine Mile Creek. The following companies did considerable development during the year: The Nine Mile Mining Co., the Ruth Consolidated Mining & Milling Co., the Coeur d'Alene Mining & Smelting Co., the Lansing Silver-Lead Mining Co., the North Star Mining & Development Co., the Savage Mining Co., and the Western Mines (Ltd.).

Summit district (*Murray*).—One placer and three lode mines in the Summit district produced 1,422 tons of ore, $319 in gold, 10,642 ounces of silver, 2,578 pounds of copper, 511,770 pounds of lead, and 51,546 pounds of zinc, valued in all at $42,089; the ore had an average value of $29.50 in metals a ton. Most of the ore in the district was lead ore of milling grade from the Cedar Creek property east of Murray. The new 100-ton flotation plant operated intermittently four months and treated 1,235 tons of lead ore, making 380 tons of lead concentrates. This product, which contained 10,130 ounces of silver and 416,866 pounds of lead, was shipped to Bradley for smelting. The Cedar Creek Mining & Development Co. (Ltd.) worked the mine nine months, after which it was shut down on account of a fire that destroyed the compressor house. One car of lead ore was shipped from the Terrible Edith mine of the Pontiac Mining Co., and one car of rich lead ore and several cars of lead-zinc milling ore were marketed from the Orofino property east of Murray. The Bear Top Mining Co. shipped no ore in 1929, but a little development was done and the mill was rebuilt so as to increase its capacity to 200 tons a day.

Yreka district (*Kellogg*).—Eleven lode mines and two tailings dumps in the Yreka district produced 655,827 tons of ore and 24,173 tons of old tailings, yielding $1,405 in gold, 2,557,285 ounces of silver, 267,271 pounds of copper, 105,917,847 pounds of lead, and 16,020,710 pounds of zinc, valued in all at $9,141,669, or $13.44 in metals a ton. The output consisted of 3,312 tons of first-class smelting ore and 652,515 tons of milling ore, which, with 24,173 tons of old tailings, yielded 111,858 tons of concentrates. The Yreka district ranked second in the value of the State's metal output in 1929, following the Hunter district, which took first place.

The Bunker Hill & Sullivan Mining & Concentrating Co. operated its mine at Kellogg continuously; the West or main mill of 1,300 tons capacity was operated on Bunker Hill ore, and the 500-ton South or Star mill on Star ore and old tailings from the Bunker Hill mine. The Sweeny 200-ton mill was operated the entire year on complex lead-zinc ore received from custom shippers, chiefly the Sidney mine in the Pine Creek area. A publication[17] describing the milling methods of the West, South, Sweeny, Crescent, and Deadwood mills appeared in 1930. The company controlled the operations of several mining properties near by, including the Crescent, Caledonia, and Sierra Nevada. In 1929 the Bunker Hill property was the largest producer of silver and lead in Idaho and ranked eighth as a producer of zinc. According to the company's printed report for 1929 the mine produced 451,111 tons of ore, which was reduced to 75,451 tons of concentrates containing 1,756,494 ounces of silver and 84,067,226 pounds of lead. This output, however, does not include first-class smelting ore shipped from the Bunker Hill property, lead-zinc ore mined by lessees and shipped to the Sweeny custom mill, or the zinc product saved from the lead ore fed to the regular mill. At the various plants near Kellogg the company mines, mills, smelts, and refines its ores and disposes of fine gold and silver, pig lead, and antimonial lead. With the addition of the new electrolytic zinc plant at Silver King, the company, through its subsidiary, also marketed exceptionally fine zinc, and with the completion of an electrolytic cadmium plant early in 1930 the company will also be able to market cadmium. The mine is opened by the 14,000-foot Kellogg tunnel, which intersects the mine workings nearly 1,800 feet below the outcrop. From this tunnel there are two inclined winzes to the 1,900-foot level; about 6,600 feet of development was done in 1929. An article[18] describing mining methods used at the Bunker Hill property was printed early in 1930. According to the figures given to the county assessor the company extracted 451,111 tons of ore (excluding lessees' ore), which had a gross value of $7,227,811. The cost of extraction was $2,164,117, freight and treatment $2,566,595, and betterment and repairs $59,526; the net profit was $2,437,573, the largest of any mining company in Idaho. Dividends aggregated $3,009,042 in 1929, or a total of $45,781,552 paid since 1890. In the South mill, which adjoins the main mill, the company treated more than 12,000 tons of old lead-zinc tailings from the Bunker Hill property.

The ore milled on company account was reduced to 75,451 tons of concentrates, which contained 55.71 per cent of lead, 5.15 per cent of zinc, and 23.28 ounces of silver to the ton. The ratio of concentration was 5.98 to 1, and the costs per ton mined were as follows: Mining, $3.815; concentrating, $1.096; shipping, $0.05; and other costs, $0.363; a total of $5.324. From 1886 to the end of 1929 the company has mined 13,009,945 tons of ore having a gross value of $156,637,497. Net smelter returns were $97,047,219, and operating profit was $54,268,150.

The Bunker Hill smelter and refinery ran continuously in 1929, largely on ore and concentrates from the Bunker Hill and Hecla mines, but partly on custom ore from western States, Alaska, and British Columbia. The output of the smelter in 1929 was 69,295 tons of lead, 8,544,009 ounces of silver, 1,209,789 pounds of copper in by-product form, and 35,888 ounces of gold from purchased ores, compared with 67,659 tons of lead and 7,807,000 ounces of silver in 1928. The corresponding figures for copper and gold were not given in 1928. During the latter part of 1929 and early in 1930 the capacity of the lead refinery was nearly doubled by the addition of new crucibles, furnaces, casting machinery, etc. Additional notes from the company's annual report follow:

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[17] Handy, R. S., Milling Methods and Costs at the Northern Idaho Mills of the Bunker Hill & Sullivan Mining & Concentrating Co.: Inf. Circ. 6314, Bureau of Mines, August, 1930, 53 pp.

[18] Brown, U. E., Mining Practice at Bunker Hill & Sullivan: Min. Cong. Jour., vol. 16, No. 1, January, 1930, p. 21.

> The output and earnings of the Bunker Hill mine were very close to that of each of the two preceding years; mine run tonnage was slightly less but the grade was a little better. Because of greater depth, increased development work, and a wider range of distribution of ore bodies, mining costs were somewhat higher than for recent preceding years; this was largely offset, however, by other economies, especially the recovery of zinc which, as noted in the last annual report, was begun during 1928. * * *
>
> While our work during midyear resulted in splendid earnings, these were substantially cut by the decreased metal prices of the late fall and winter, yet the mine operating profit for the entire year compared favorably with profits of 1927 and 1928.
>
> With the termination of our 1918 contract with the American Smelting & Refining Co., which contract has heretofore required us to ship one-half of the output of the Bunker Hill mine to the smelting plants of that company for treatment, the Bunker Hill smelter and refinery will now be in a position to receive the entire output of the mine, thus entering a period of increased activity and greater earnings. * * *
>
> Development work on the lower levels of the Bunker Hill mine was continued vigorously throughout the year, the usual practice being supplemented by diamond drilling. Shaft sinking is being resumed to develop at deeper levels the ore already proven on the No. 19, bottom level of the mine, and in the effort to disclose at lower levels the "Towers-March-July" ore shoot. * * *
>
> We have 2,061,213 tons of ore blocked out to date in the Bunker Hill mine and 383,320 tons in the Sullivan mine.

An article[19] describing the procedure at the Bunker Hill lead refinery was published in February, 1930. The Parkes process of lead refining is used at Bradley, Idaho, but the practice differs to some extent from that of other plants in the United States using the same process.

The process of the electrolytic zinc plant at Silver King, which was operated at a normal rate during the year, has already been described.[20] The report of the Bunker Hill & Sullivan Mining & Concentrating Co. for 1929 gives the following paragraph regarding the plant of the Sullivan Mining Co.:

> Since beginning production in November, 1928, the zinc reduction plant has produced to the 1st of January, 1930, 18,520.65 tons of "Bunker Hill" brand electrolytic zinc, all of purity better than 99.99 per cent. A substantial premium over Prime Western zinc prices has been received for all of this zinc sold. A wide distribution of sales has been made among users of zinc with unanimous appreciation of this new superfine metal, a material heretofore never available to industry. During the first eight months of the year this zinc producing enterprise earned a fair profit, considering the substantial initial outlays necessary for plant organization and adjustment to a normal working basis. But with the slowing up of sales and decline in prices, beginning with August last, this operating profit disappeared, the net result of the year showing a loss, with a large stock of zinc on hand accumulated during the last few months of the period.

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[19] Beasley, Alfred F., Lead Refining at the Bunker Hill Smelter of the Bunker Hill & Sullivan Mining & Concentrating Co.: Trans. Am. Inst. Min. and Met. Eng., February, 1930.

[20] Tainton, U. C., The Sullivan Electrolytic Plant: Eng. and Min. Jour., vol. 126, Dec. 1, 1928, p. 856; Miller, Raymond M., New Electrolytic Zinc Plant of Sullivan Mining Co.: Min. Cong. Jour., vol. 15, No. 1, January, 1929, p. 70.

The new 120-ton flotation plant on the Crescent property was operated the entire year on a 12-hour basis and treated more than 21,000 tons of copper-lead ore. Copper-lead concentrates, valuable chiefly for the silver content, were shipped to Bradley for smelting. The mine was worked continuously on an 8-hour basis and ranked fifth as a producer of silver in Idaho in 1929. According to the figures given to the county assessor, 21,604 tons of ore was extracted, which had a gross value of $183,658. The cost of extraction was $106,215, freight and treatment $32,149, and betterment and repairs $95,617; the net loss was $50,323. The Hooper tunnel of the Crescent property was advanced, under contract, 4,600 feet and at a point about 1 mile from the portal the Crescent ore body was intersected nearly 500 feet below the upper workings. The ore is of milling grade and was said to be 4 feet thick.

The Caledonia property was operated by lessees, who shipped 1,464 tons of silver-lead ore from old stope fillings. According to a statement of operations for 1929 published by the company, the ore contained 25,318 ounces of silver and 83,500 pounds of lead, which sold for $19,438. Smelter charges amounted to $9,319, and the company received a royalty of $1,518; after interest on bonds was credited and general expenses paid the profit was $357 and the surplus $64,769.

The mill of the Constitution Mining & Milling Co. ran from June to the end of the year and treated more than 12,000 tons of complex lead-zinc ore; concentrates were shipped to the electrolytic plant at Great Falls, Mont. The property is equipped with a 150-ton flotation plant, but the lead and zinc minerals are so closely associated that separate lead and zinc products are not made. The mill equipment includes a crusher, rolls, ball mills, Dorr thickener, and a variety of flotation machines. The froth from the cleaners is a collective lead-zinc concentrate. The mine, which was active throughout the year, is developed by a main tunnel 2,508 feet long, by a vertical shaft 400 feet deep, and by various drifts and raises. In 1929 the company spent $100,000 for new mine equipment, the shaft was sunk an additional 200 feet, and a new level was opened and drifted on for 750 feet. This work was said to have opened much new ore. An article[21] describing the improvements made during the year appeared in September. The mine ranked tenth as a producer of zinc in Idaho in 1929 and was also a large producer of lead and silver. According to the figures given to the county assessor 12,304 tons of ore was extracted, which had a gross value of $139,772. The cost of extraction was $88,618, freight and treatment $64,995, and betterment and repairs $43,075; the net loss was $56,916.

The Federal Mining & Smelting Co. operated the Page and Blackhawk mines, both producers of lead-zinc ore. The 300-ton flotation plant at the Page mine was operated the entire year on ore from both properties, and the company shipped about 14,300 tons of lead concentrates and zinc concentrates to plants in Montana and California. The Page mine is opened by an inclined shaft 1,275 feet deep and by 12,730 feet of tunnels, drifts, and crosscuts; 3,701 feet of development in drifting, raising, and crosscutting was done in 1929. From 86,027 tons of lead-zinc ore of milling grade lead concentrates were produced that contained 205,721 ounces of silver and 13,714,729 pounds of lead, and zinc concentrates that contained 21.96 ounces of gold, 7,997 ounces of silver, 143,274 pounds of lead, and 1,872,249 pounds of zinc. The ore contains galena, sphalerite, siderite, and pyrite. The mine ranked fourth as a producer of lead in Idaho in 1929, eleventh as a producer of zinc, and tenth as a producer of silver. According to the figures given to the county assessor, the concentrates had a gross value of $1,204,745. The cost of extraction was $522,591, freight and treatment $366,659, and betterment and repairs $43,162; the net profit was $272,333. The report of the Federal Mining & Smelting Co. gives the following paragraph:

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[21] White, William F., New Plant and Equipment at the Constitution Mine: Min. Cong. Jour., vol. 15, September, 1929, p. 667.

> During 1929 the Tony vein was opened to a further depth of 300 feet, to the 1,200 level, and it was developed for the full length of the ore shoot. It is not quite so wide as on the 900 level, but this is partly compensated by the fact that the ore is of somewhat higher grade.

The ore treated contained 9.01 per cent of lead, 2.60 per cent of zinc, and 2.74 ounces of silver to the ton.

The Blackhawk mine was worked through the Page property, and 12,909 tons of lead-zinc ore were treated in the Page flotation plant. The lead concentrates contained 30,834 ounces of silver and 2,080,116 pounds of lead, and the zinc product contained 3.10 ounces of gold, 1,116 ounces of silver, 19,752 pounds of lead, and 247,400 pounds of zinc. The earnings in 1929 were $16,029. The property is opened by 12,661 feet of workings, and about 2,400 feet of development, chiefly in drifts, was done in 1929. The report of the Federal Mining & Smelting Co. says:

> In the Blackhawk ground the Curlew vein was further developed on the 900 level; and two more ore shoots were opened. The development in this mine was much more encouraging than in the preceding year. The ore reserves at the end of the year are estimated at 538,200 tons, compared with 270,000 tons at the end of 1928.

The Sidney Leasing Co. operated the Sidney mine the entire year and shipped more than 47,000 wet tons of lead-zinc ore by way of the 3½-mile aerial tramway to the Government Gulch spur of the Oregon-Washington Railroad & Navigation Co. The ore was treated at the Sweeny mill and separated by flotation into lead concentrates and zinc concentrates. The lead product was sold to the Bunker Hill smelter, and the zinc concentrates were shipped for treatment in the new electrolytic zinc plant of the Sullivan Mining Co. The milling ore contained 96,994 ounces of silver, 5,227,358 pounds of lead, and 12,178,048 pounds of zinc. The mine ranked third as a producer of zinc in Idaho in 1929, thirteenth as a producer of lead, and fifteenth as a producer of silver. Development in 1929 consisted of sinking the shaft an additional 150 feet to the eighth level. The mine is opened by several short tunnels, one of which is about 900 feet long, and an inclined winze to the 800-foot level. Drifting in 1929 was done chiefly on the 700-foot level, where a large quantity of milling ore was reported to have been blocked out. A new compressor, as well as other surface equipment, was installed during the year. According to the figures given to the county assessor 47,351 tons of ore were extracted, which had a gross value of $219,930. The cost of extraction was $161,912, freight and treatment $11,712, and betterment and repairs $13,945; the net profit was $32,361. A royalty was paid to the Sidney Mining Co., which reported a net profit of $35,081. The Sidney Leasing Co. paid a dividend in 1929 amounting to $14,430, which makes a total of $64,935 paid to date.

The Hayes Co. treated about 12,000 tons of old creek tailings in a 100-ton flotation plant equipped with 18 Fahrenwald cells. The resulting lead concentrates, which were hauled 4 miles by truck to the Bunker Hill smelter, contained 21,116 ounces of silver and 450,266 pounds of lead. The production in 1929 was unusually small as the work of treating these tailings was completed and milling operations were suspended late in the year.

Lessees operated the Sierra Nevada property in Government Gulch and shipped several cars of lead-zinc ore to the Sweeny custom mill to be treated by flotation; several cars of lead ore from the dump were shipped to Bradley for smelting.

The Bobby Anderson Group Mining Co. shipped two cars of lead-zinc ore from its property on Pine Creek to custom milling plants at Kellogg and Wallace. Development carried on throughout the year consisted chiefly of driving crosscuts from the winze to the new ore body. The Douglas Mining Co. operated its group of 15 claims in the Pine Creek section and during the year shipped more than 300 tons of lead-zinc ore to the Sweeny custom mill. The property is opened by a tunnel 1,900 feet long and by an inclined winze, which during 1929 was deepened to a point 300 feet below the tunnel level. Considerable mill ore is reported to be available on the 300-foot level of the mine.

Other companies operating in the Yreka district did development but shipped no ore during 1929. The Commercial Traveler Mining Co. extended the No. 3 tunnel at the Star-Antimony group more than 800 feet. The General Mines Corporation installed a compressor and other surface equipment at its Big 8 property on Pine Creek and extended the tunnel 550 feet. The Hypotheek Mining & Milling Co. did 1,500 feet of drifting on the 700 and 900 foot levels of its property. The New Jersey Consolidated Mines Co. erected new surface buildings and a headframe, installed a compressor and a new hoist, deepened the shaft 220 feet, and did considerable drifting and crosscutting at the King of Pine Creek property. The Pine Creek Lead-Zinc Co., operating the Little Pittsburg property near Masonia, transferred its surface equipment from No. 2 to No. 3 tunnel, did considerable drifting and crosscutting which opened much milling ore, and in November started constructing a 250-ton flotation mill. The Lookout Mountain Mining & Milling Co. operated property in the Pine Creek section which is opened by a 5,000-foot tunnel and a 200-foot winze, deepened the winze 100 feet, and did about 1,500 feet of drifting on the 300-foot level. The Blue Eagle Mining Co., operating the Blue Eagle group adjoining the Douglas and Highland-Surprise properties, installed a compressor and extended the No. 2 tunnel. The Wolverine Mining Co., operating the Wolverine group in the Big Creek section, installed a new compressor and hoist, deepened the shaft from the 150-foot level to the 500-foot level, and did about 1,000 feet of drifting on the lower level. The North Bunker Hill Mining Co., developing claims near Kellogg, did about 300 feet of drifting and crosscutting.

TWIN FALLS COUNTY

Snake River district (*Twin Falls*).—A small quantity of placer gold was recovered by sluicing operations at the Sandy Bar property on the Snake River near Twin Falls.

VALLEY COUNTY

The value of the production of metals in Valley County increased from $3,843 in 1928 to $43,665 in 1929, as a result of milling silver-lead-zinc ore from the Lost Pilgrim & Hall-Interstate property, operated by the Bunker Hill & Sullivan Mining & Concentrating Co.

Deadwood Basin district (*Cascade*).—The entire output from the Deadwood Basin district was that made by the Bunker Hill & Sullivan Mining & Concentrating Co. from the Lost Pilgrim & Hall-Interstate property. The new 100-ton flotation mill at this property was completed in 1928 and during 1929 the company treated 2,729 tons of lead-zinc ore, which yielded 415 tons of lead concentrates and zinc concentrates containing 25 ounces of gold, 17,723 ounces of silver, 13,118 pounds of copper, 165,208 pounds of lead, and 324,164 pounds of zinc. The mine was worked continuously during the year, and in addition to stoping operations more than 600 feet of development was done. The mill was operated only four months because of insufficient power, but a new hydroelectric power plant was afterward installed and the property is now completely equipped for continuous operations. An article[22] describing the milling operations was issued early in 1930.

Edwardsburg district.—The Big Creek Gold Mines (Inc.) installed a pipe line and a water-driven compressor, built a sawmill, and did considerable exploration work on the Snow Shoe group near Ramey Ridge. Development was also done by the Keystone Gold Mines (Inc.) and the Smith Creek Hydraulic Mining Co. (Inc.).

Hurdy Creek district.—The Hurley Creek Mining & Milling Co. continued to develop the Maloney group.

Thunder Mountain district.—The Sunnyside Mining & Milling Co. produced about 1,000 tons of siliceous gold ore, which was treated in a small 10-stamp amalgamation mill. Gold bullion valued at about $3,700 was sent to the assay office at Boise.

Yellow Pine district.—No production was reported from the Yellow Pine district in 1929, but three companies did active development. The Yellow Pine Co., which controls the Meadow Creek and Cinnabar groups, constructed 12 miles of highway from Yellow Pine to Meadow Creek, erected a new mining plant at the portal of the Meadow Creek tunnel, and completed nearly 2,500 feet of drifting and 1,600 feet of diamond drilling. A lower tunnel was started about a mile north of the Meadow Creek tunnel, and a third tunnel was being driven to open the Cinnabar group at depth. The Profile-Tamarack Mines Co. did several hundred feet of development on a group of claims on Missouri and Profile Creeks, and the Amalgamated Red Metals Mines Co. equipped the Red Metals group with a sawmill, hydroelectric power plant, compressor, and a 25-ton milling plant.

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[22] Gwinn, J. W., The Hall-Interstate Mill: Idaho Engineer, University of Idaho, Moscow, May, 1930, p. 71.

WASHINGTON COUNTY

Heath district.—One car of oxidized lead ore was marketed from the Keystone property, and a little development was done by the Cuddy Mountain Gold Mining Co., the Edna May Mines (Inc.), and the Baw Mining Co.

Washington (Mineral Creek) district.—Three cars of oxidized copper ore containing about 30 ounces of silver to the ton were shipped from the Doris and Silver Still groups, 7 miles from Home, Oreg. The property was worked by the Silver Still Mining Co. and about 300 feet of tunnel work was done in 1929.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN WASHINGTON[1]

(MINE REPORT)

By C. N. GERRY and T. H. MILLER[2]

SUMMARY

The value of the mine production of gold, silver, copper, lead, and zinc in Washington in 1929 was nearly 13 per cent less than that in 1928. The large decrease in the output of gold and silver offset the decided increase in the output of copper and zinc; the output of lead decreased slightly. The largest decreases were in gold and silver from Ferry County and in lead from Stevens County. There was, however, a good increase in the output of lead from Pend Oreille County, which nearly offset the large decrease in lead from Stevens County. The total value of the metal output of Washington in 1929 was much less than the yearly average for the decade 1920 to 1929, which was about $819,200.

Since 1860 Washington has yielded an output of the five metals as follows: Gold, $30,334,997; silver, 9,251,864 fine ounces; copper, 25,648,650 pounds; lead, 62,057,331 pounds; and zinc, 14,977,752 pounds. The total value has amounted to $47,115,260, of which 64 per cent represents the value of the gold. During the decade 1920 to 1929 gold represents 28 per cent of the total value of the metal output; silver, 16 per cent; copper, 20 per cent; lead, 26 per cent; and zinc, 10 per cent. No dividends were paid by any mining company in the State in 1929.

The value of the metal output of Pend Oreille County increased more than $174,000 because of the increased output of lead-zinc ore from the Grandview mine near Metaline Falls, but the value of the metal output of Ferry County decreased nearly $284,000, as the large gold-producing mines near Republic were idle largely because the smelting company at Trail, British Columbia, refused to receive shipments of siliceous ore. Shipments of lead ore from the mines near Northport, Stevens County, decreased considerably, and the total value of the metal output of the county decreased from $89,396 in 1928 to $53,885 in 1929. Nearly 44 per cent of the total value of the State output in 1929 came from the Sunset mine near Index, Snohomish County. As the average price of copper increased from 14.4 cents a pound in 1928 to 17.6 cents a pound in 1929 the Sunset Copper Co., increased its shipments of copper concentrates.

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[1] Work on manuscript completed January, 1931.

[2] The valuable assistance of Jeannette Froiseth and Paul Luff, of the Bureau of Mines, is acknowledged.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1920 to 1922 is New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1920	$1.09	$0.184	$0.080	$0.081	1925	$0.694	$0.142	$0.087	$0.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064
1923	.82	.147	.070	.068	1928	.585	.144	.058	.061
1924	.67	.131	.080	.065	1929	.533	.176	.063	.066

Mine production of gold, silver, copper, lead, and zinc in Washington, 1920–1929, in terms of recovered metals

Year	Mines producing		Ore and old tailings (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1920	35	9	85,318	5,846.60	$120,860	199,678	$217,649
1921	26	11	22,885	6,215.51	128,486	142,450	142,450
1922	33	13	36,046	9,044.43	186,965	205,046	205,046
1923	30	6	56,900	16,547.49	342,067	227,187	186,293
1924	30	4	44,383	14,977.72	309,617	213,742	143,207
1925	37	9	50,287	11,138.49	230,253	166,425	115,499
1926	49	9	54,343	9,340.82	193,092	171,649	107,109
1927	30	3	119,201	19,513.51	403,380	155,850	88,367
1928	37	1	64,554	16,310.45	337,167	99,738	58,347
1929	29	4	93,527	3,719.94	76,898	47,182	25,148

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1920	1,983,134	$364,897	5,787,247	$462,980	426,496	$34,546	$1,200,932
1921	251,544	32,449	143,553	6,460	449,360	22,468	332,313
1922	317,203	42,822	1,381,199	75,966	1,228,229	70,009	580,808
1923	871,999	128,184	2,906,479	203,454	3,024,535	205,668	1,065,666
1924	928,458	121,628	3,935,376	314,830	910,890	59,208	948,490
1925	1,159,057	164,586	5,627,241	489,570	1,217,846	92,556	1,092,464
1926	1,351,890	189,265	4,546,228	363,698	1,044,354	78,327	931,491
1927	1,685,848	220,846	955,003	60,165	1,279,710	81,901	854,659
1928	1,177,246	169,523	1,084,739	62,915	85,318	5,204	633,156
1929	1,400,489	246,486	1,015,190	63,956	2,117,344	139,745	552,233

Gold and silver produced at placer mines in Washington, 1920–1929, in fine ounces

Year	Gold	Silver	Year	Gold	Silver
1920	71.20	16	1925	52.87	11
1921	148.66	48	1926	1,354.50	456
1922	162.44	49	1927	18.82	5
1923	73.09	23	1928	90.85	30
1924	33.77	12	1929	295.76	98

GOLD

The production of gold in Washington in 1929 was the smallest that has ever been recorded. The output decreased from 16,310.45 ounces in 1928 to 3,719.94 ounces in 1929. The large decrease was due chiefly to the fact that the Consolidated Mining & Smelting Co. of Canada (Ltd.), at Trail, British Columbia, required no siliceous ore from the mines at Republic, Ferry County. The production of gold from Whatcom County in 1929 was also less than that of 1928. Ore amalgamated yielded 72 per cent of the total gold, ore shipped direct to smelters yielded 15 per cent, ore concentrated yielded nearly 5 per cent, and placers yielded 8 per cent. Nearly 72 per cent of the total gold was recovered from gold ore from the Boundary Red Mountain mine in Whatcom County; most of the remainder came from gold ore from the Old Republic mine in Ferry County and from dredging operations in Kittitas County.

SILVER

The production of silver in Washington in 1929 was the smallest that has ever been recorded. The output decreased from 99,738 ounces in 1928 to 47,182 ounces in 1929. A decrease of 61,570 ounces was recorded in the output of Ferry County, but a slight increase was recorded in Snohomish County. More than 67 per cent of the total output of silver came from the Sunset mine near Index, Snohomish County, and from the United Copper mine near Chewelah, Stevens County. Crude ore shipped to smelters yielded 53 per cent of the total silver and concentrates nearly all of the remainder. Copper ore yielded 68.6 per cent of the total silver, lead ore and lead-zinc ore 16.5 per cent, and siliceous ore 14.7 per cent.

COPPER

The production of copper in Washington in 1929 increased 19 per cent in quantity over that of 1928 and was more than the annual average output for the decade 1920 to 1929, which was 1,112,700 pounds. Most of the copper (87 per cent) produced in 1929 resulted from milling operations at the Sunset mine near Index, Snohomish County; the output increased 19 per cent as compared with that of 1928. A little crude copper ore was shipped from Leavenworth, Chelan County; Castlerock, Skamania County; Index, Snohomish County; and Davenport and Chewelah, Stevens County.

LEAD

The production of lead in Washington in 1929 decreased more than 6 per cent in quantity compared with 1928 as a result of the large decrease in the output of lead from the Gladstone mine near Northport, Stevens County. The decrease in the total output of lead would have been much greater, but the large quantity of lead-zinc ore produced at the Grandview mine near Metaline Falls, Pend Oreille County, increased the total output and nearly offset the decrease in lead from the Gladstone mine. The Grandview mine produced about 64 per cent of the State's output of lead in 1929; the remainder came chiefly from the Bonanza property near Bossburg and from the Electric Point mine near Northport, both in Stevens County. In 1926, when the Gladstone mine produced heavily, the mines of Washington produced 4,546,228 pounds of lead.

ZINC

The production of zinc in Washington in 1929 was 2,117,344 pounds, which was fairly close to the record output of 1923, when 3,024,535 pounds were produced. The large production made in 1929 was due chiefly to the activity of the flotation mill of the Grandview Mines (Inc.) near Metaline Falls, Pend Oreille County. Small quantities of zinc were produced from the Josephine mine at Metaline Falls, Pend Oreille County, and from the Old Dominion mine near Colville, the Middleport mine at Middleport, and the Great Western mine near Northport, all in Stevens County.

Mine production of gold, silver, copper, lead, and zinc in Washington in 1929, by counties, in terms of recovered metals

County	Gold (lode and placer)		Silver (lode and placer)	
	Fine ounces	Value	Fine ounces	Value
Chelan	1.02	$21	316	$169
Ferry	510.41	10,551	3,628	1,934
Garfield	2.95	61	2	1
Kittitas	293.78	6,073	589	314
Okanogan	4.98	103	4	2
Pend Oreille	8.03	166	2,250	1,199
Skamania			40	21
Snohomish	184.21	3,808	17,614	9,388
Stevens	40.68	841	22,598	12,045
Whatcom	2,673.88	55,274	141	75
Yakima				
	3,719.94	76,898	47,182	25,148
Total, 1928	16,310.45	337,167	99,738	58,347

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Chelan	4,654	$819					$1,009
Ferry	1,167	205	7,015	$442			13,132
Garfield							62
Kittitas	55	10	402	25			6,422
Okanogan	426	75					180
Pend Oreille	4,762	838	655,958	41,325	2,061,574	$136,064	179,592
Skamania	6,711	1,181					1,202
Snohomish	1,296,038	228,103					241,299
Stevens	86,103	15,154	351,815	22,164	55,770	3,681	53,885
Whatcom							55,349
Yakima	573	101					101
	1,400,489	246,486	1,015,190	63,956	2,117,344	139,745	552,233
Total, 1928	1,177,246	169,523	1,084,739	62,915	85,318	5,204	633,156

Ore and old tailings sold or treated, lode mines producing, and average value of ore and old tailings in gold and silver in Washington, 1928 and 1929, by counties

County	Ore and old tailings (short tons)		Lode mines producing		Average value per ton in gold and silver	
	1928	1929	1928	1929	1928	1929
Chelan		32		1		$5.94
Ferry	28,978	382	8	4	$10.25	32.68
Garfield		1		1		62.00
Kittitas		12		1		27.00
Okanogan	39	2	3	1	26.31	1.00
Pend Oreille	700	50,920	1	2	.63	.27
Pierce	12		2		.83	
Skagit	5		1		7.00	
Skamania		76		1		.28
Snohomish	27,925	33,608	2	1	.31	.39
Stevens	2,145	3,796	19	15	6.49	3.39
Whatcom	4,750	4,694	1	1	15.27	11.79
Yakima		4		1		
	64,554	93,527	37	29	6.10	1.03

MINING INDUSTRY

In spite of an interesting increase in the production of zinc and a slight increase in copper production in Washington in 1929 the value of the metal output was less than that of 1928. As there was a marked decrease in gold and silver from the Republic district, Ferry County, the production of the State came chiefly from three mines, the Sunset copper property near Index, Snohomish County; the Grandview lead-zinc property at Metaline Falls, Pend Oreille County; and the Boundary Red Mountain gold mine in Whatcom County. The most interesting feature of the year was the development and construction work in the Metaline district, Pend Oreille County, which resulted in a greatly increased production of lead and zinc concentrates. The substantial improvements at the Grandview property, including the equipment and operation of a modern flotation plant, and development done at the Pend Oreille Mines & Metals property near by stimulated interest in this region. It is hoped that with better metal prices to encourage the work at Metaline Falls and with the prospect of having a regular producer in the property of the Royal Development Co. in Chelan County better results may soon be shown in Washington's metal output, chiefly in copper, lead, and zinc.

ORE CLASSIFICATION

Ore and old tailings sold or treated in Washington, 1920–1929, with content in terms of recovered metals

Year	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
DRY AND SILICEOUS ORE						
1920	13,096	5,549.82	45,977	2,073	1,743	
1921	20,199	6,015.38	68,991	3,293	3,339	
1922	24,782	8,830.87	106,243	2,189	17,759	
1923	33,499	16,348.92	127,029	349	4,467	
1924	17,575	14,706.15	70,178	510		
1925	15,383	10,876.19	43,083	16		
1926	17,599	7,707.83	56,556	522		
1927	43,450	19,342.20	115,684	53	1,929	
1928	33,956	16,098.60	70,191	121	1,911	
1929	5,162	3,224.85	6,932	261	1,425	
COPPER ORE						
1920	62,814	223.59	146,820	1,975,604		
1921	1,332	24.91	65,716	246,017		
1922	6,086	38.40	68,239	312,912	239	
1923	11,128	80.01	60,805	855,152		
1924	15,916	117.70	44,173	927,407		
1925	19,500	139.80	37,131	1,158,812		
1926	25,297	190.98	18,456	1,348,545		
1927	37,564	139.00	35,926	1,684,450		
1928	28,560	117.00	22,937	1,165,342		
1929	34,145	189.20	32,377	1,393,769		
LEAD ORE						
1920	8,660	1.99	4,123		5,753,976	
1921	354	26.56	7,695	2,234	136,974	
1922	3,624	12.72	30,463	2,102	1,363,201	
1923	7,881	43.44	36,819	1,341	2,859,032	
1924	8,111	120.10	99,300	541	3,916,260	
1925	11,518	57.43	77,618	24	5,591,348	
1926	7,659	75.27	82,733	2,823	4,450,458	
1927	1,648	7.26	1,939	270	824,423	
1928	[1]904	[1]2.68	[1]5,675	[1]736	[1]1,011,970	
1929	3,176	2.10	4,003	1,697	328,894	

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[1] Revised figures.

Ore and old tailings sold or treated in Washington, 1920–1929, with content in terms of recovered metals—Continued

COPPER-LEAD ORE

Year	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1920	90	----------	2,742	5,457	25,708	----------
1921–22	----------	----------	----------	----------	----------	----------
1923	942	2.03	2,511	15,157	42,980	----------
1924–1927	----------	----------	----------	----------	----------	----------
1928	700	1.00	721	11,047	55,085	----------
1929	----------	----------	----------	----------	----------	----------

ZINC ORE AND LEAD-ZINC ORE

Year	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
1920	658	----------	----------	----------	5,820	426,496
1921	1,000	----------	----------	----------	3,240	449,360
1922	1,554	----------	52	----------	----------	1,228,229
1923	3,450	----------	----------	----------	----------	3,024,535
1924	2,781	----------	79	----------	19,116	910,890
1925	3,886	12.20	8,582	205	35,893	1,217,846
1926	3,788	12.24	13,448	----------	95,770	1,044,354
1927	36,539	6.23	2,296	1,075	128,651	1,279,710
1928	[1] 434	[1] .32	[1] 184	(1)	[1] 15,773	85,318
1929	51,044	8.03	3,772	4,762	684,871	2,117,344

[1] Revised figures.

Ore and old tailings sold or treated in Washington, 1928 and 1929, with content in terms of recovered metals

Source	Mines producing	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
1928		*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	13	[1] 33,898	16,097.84	65,421	----------	----------	----------
Dry silver ore	4	58	.76	4,770	121	1,911	----------
Copper ore	6	28,560	117.00	22,937	1,165,342	----------	----------
Lead ore	[2] 11	[2] 904	[2] 2.68	[2] 5,675	[2] 736	[2] 1,011,970	----------
Zinc ore	1	350	----------	----------	----------	----------	55,731
Lead-zinc ore	2	[2] 84	[2] .32	[2] 184	(2)	[2] 15,773	29,587
Copper-lead ore	1	700	1.00	721	11,047	55,085	----------
Total, lode mines	[3] 37	64,554	16,219.60	99,708	1,177,246	1,084,739	85,318
Total, placers	1	----------	90.85	30	----------	----------	----------
	38	64,554	16,310.45	99,738	1,177,246	1,084,739	85,318
1929							
Dry gold ore	5	5,120	3,220.59	3,222	169	----------	----------
Dry silver ore	3	42	4.26	3,710	92	1,425	----------
Copper ore	8	34,145	189.20	32,377	1,393,769	----------	----------
Lead ore	9	3,176	2.10	4,003	1,697	328,894	----------
Lead-zinc ore	5	51,044	8.03	3,772	4,762	684,871	2,117,344
Total, lode mines	[3] 29	93,527	3,424.18	47,084	1,400,489	1,015,190	2,117,344
Total, placers	4	----------	295.76	98	----------	----------	----------
	33	93,527	3,719.94	47,182	1,400,489	1,015,190	2,117,344

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[1] Includes 130 tons of old tailings amalgamated.

[2] Revised figures.

[3] A mine producing more than one class of ore is counted but once in arriving at total for all classes.

Value of metals from ore and old tailings sold or treated in Washington, 1928 and 1929, by classes of ore

Class	Ore and old tailings (short tons)	Gold	Silver	Copper	Lead	Zinc	Total
1928							
Dry gold ore	33,898	$332,772	$38,271				$371,043
Dry silver ore	58	16	2,791	$17	$111		2,935
Copper ore	28,560	2,418	13,418	167,809			183,645
Lead ore	[1] 904	[1] 55	[1] 3,320	[1] 106	[1] 58,694		[1] 62,175
Zinc ore	350					$3,399	3,399
Lead-zinc ore	[1] 84	[1] 7	[1] 107	(1)	[1] 915	1,805	[1] 2,834
Copper-lead ore	700	21	422	1,591	3,195		5,229
	64,554	335,289	58,329	169,523	62,915	5,204	631,260
1929							
Dry gold ore	5,120	66,576	1,717	30			68,323
Dry silver ore	42	88	1,977	16	89		2,170
Copper ore	34,145	3,911	17,257	245,303			266,471
Lead ore	3,176	43	2,134	299	20,720		23,196
Lead-zinc ore	51,044	166	2,011	838	43,147	139,745	185,907
	93,527	70,784	25,096	246,486	63,956	139,745	546,067

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[1] Revised figures.

DRY AND SILICEOUS ORE

Most of the dry and siliceous ore (nearly 91 per cent) in 1929 was gold ore from the Boundary Red Mountain mine in Whatcom County. The total output of gold ore in 1929 was less than one-sixth that of 1928, as the mines at Republic were idle. The total value of metals recovered from gold ore was $68,323; the material averaged $13 in gold and 0.63 ounce of silver to the ton.

A small quantity of silver ore was marketed in 1929, but no gold and silver ore was produced. Most of the silver ore came from the Silver Queen property near Miles and the Chloride Queen mine near Colville, both in Stevens County.

COPPER ORE

Copper ore yielded metals valued at $266,471 in 1929, or nearly half the total value of the State's output; the ore averaged 11.5 cents in gold and 0.948 ounce of silver to the ton and 2.04 per cent of copper. Nearly all the copper ore came from Index, Snohomish County; it was largely milling ore. A little copper ore from the old Turk mine near Fruitland was also milled.

LEAD ORE

The metals recovered from lead ore were valued at $23,196. Most of the ore came from the waste dump of the Bonanza mine near Bossburg, Stevens County; it yielded on the average 1.26 ounces of silver to the ton, 5.18 per cent of lead, and a little copper.

LEAD-ZINC ORE

Lead-zinc ore yielded metals valued at $185,907 in 1929, and next to copper ore was the most valuable in the State. The ore yielded on the average 0.07 ounce of silver to the ton, 0.67 per cent of lead, and 2.07 per cent of zinc; nearly all of it came from the Grandview mine at Metaline Falls, Pend Oreille County.

Ore and old tailings sold or treated in Washington, 1928 and 1929, by counties, with content in terms of recovered metals

1928

DRY GOLD ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ferry	28,978	12,519.34	65,198			
Okanogan	38	43.83	13			
Stevens	[1] 132	32.14	28			
Whatcom	4,750	3,502.53	182			
	33,898	16,097.84	65,421			

COPPER ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
Pierce	12		17	1,552		
Snohomish	27,925	113.00	10,951	1,090,748		
Stevens	623	4.00	11,969	73,042		
	28,560	117.00	22,937	1,165,342		

LEAD ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
Skagit	5	0.11	56	34	1,281	
Stevens	[2] 899	[2] 2.57	[2] 5,619	[2] 702	[2] 1,010,689	
	[2] 904	[2] 2.68	[2] 5,675	[2] 736	[2] 1,011,970	

ZINC ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
Stevens	350					55,731
	350					55,731

LEAD-ZINC ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
Stevens	[2] 84	[2] 0.32	[2] 184	(2)	[2] 15,773	29,587
	[2] 84	[2].32	[2] 184	(2)	[2] 15,773	29,587

1929

DRY GOLD ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
Ferry	351	509.92	3,035			
Garfield	1	2.96	2			
Stevens	74	33.83	44	169		
Whatcom	4,694	2,673.88	141			
	5,120	3,220.59	3,222	169		

COPPER ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
Chelan	32	1.00	316	4,654		
Okanogan	2		4	426		
Skamania	76		40	6,711		
Snohomish	33,608	184.20	17,614	1,296,038		
Stevens	423	4.00	14,403	85,367		
Yakima	4			573		
	34,145	189.20	32,377	1,393,769		

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[1] Includes 130 tons of old tailings amalgamated.

[2] Revised figures.

Ore and old tailings sold or treated in Washington, 1928 and 1929, by counties, with content in terms of recovered metals—Continued

1929—Continued

LEAD ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ferry	31	0.50	593	1,167	7,015	----------
Stevens	3,145	1.60	3,410	530	321,879	----------
	3,176	2.10	4,003	1,697	328,894	----------

LEAD-ZINC ORE

County	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
Pend Oreille	50,920	8.03	2,250	4,762	655,958	2,061,574
Stevens	124	----------	1,522	----------	28,913	55,770
	51,044	8.03	3,772	4,762	684,871	2,117,344

Zinc products (as marketed from Washington mines and mills) sold to smelters or electrolytic plants in 1929

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore or concentrates	Recovered zinc
		Short tons	*Pounds*	*Per cent*	*Pounds*
Oxidized lead-zinc ore	Stevens	76	42,140	27.72	33,712
Zinc concentrates	Pend Oreille and Stevens	2,245	2,317,819	51.62	2,027,981
Lead-zinc concentrates	do	73	65,996	45.20	55,651
		2,394	2,425,955	50.67	2,117,344
Total, 1928	----------	107	96,413	45.05	85,318

METALLURGIC INDUSTRY

Of the total ore from Washington treated in 1929, 5 per cent was gold ore amalgamated (nearly all from the Boundary Red Mountain mine in Whatcom County), more than 93 per cent was ore concentrated, chiefly lead-zinc ore and copper ore, and nearly 2 per cent was crude ore shipped for smelting.

Five milling plants in Washington were active in 1929. Two used flotation, two a combination of flotation and table concentration, and one amalgamation.

Ore and concentrates from mines in Washington were smelted mainly at Bradley, Idaho, Tacoma, Wash., and Trail, British Columbia. Lead ore and concentrates were smelted at the Bunker Hill plant at Bradley, Idaho; copper material at Tacoma, Wash.; and siliceous ore, which decreased considerably, at Trail, British Columbia. Zinc concentrates were roasted and leached near Great Falls, Mont., and at Silver King, Idaho, and lead-zinc ore was shipped to Mineral Point, Wis., and to a custom mill at Wallace, Idaho. The Consolidated Mining & Smelting Co. of Canada (Ltd.) operated at Trail, British Columbia, a very complete plant for milling, smelting, and refining. The electrolytic lead refinery is of unusual interest and an electrolytic bismuth plant was completed and placed in operation early in 1930.

The ore concentrated yielded 5,013 tons of concentrates, most of which were zinc concentrates and copper concentrates; the remainder was nearly all lead concentrates. Despite the fact that Washington had so few concentration mills in operation, the ore treated in 1929 has been separated by classes and an estimate made of the gross metal content of the mill feed. The gross metal content of the concentrates is also given, as well as the metals estimated to have been recovered.

Washington ore concentrated in 1929, by classes of ore, with gross metal content of mill feed

Class	Quantity (dry weight)	Gross content of mill feed by assay				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Copper ore	33,447	202.60	18,837	1,390,090		
Lead ore	3,000	.32	2,370		216,161	
Lead-zinc ore	50,968	10.00	4,424	1,150	810,897	2,685,559
	87,415	212.92	25,631	1,391,240	1,027,058	2,685,559

Washington ore concentrated in 1929, by methods of concentration

Method of concentration	Ore concentrated	Concentrates and metal content								
		Concentrates produced	Gold	Silver	Copper		Lead		Zinc	
					Gross	Recovered	Gross	Recovered	Gross	Recovered
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Flotation	53,968	3,135	8.26	5,668	6,422	5,083	905,356	852,506	2,383,815	2,083,632
Gravity concentration and flotation	33,347	1,854	172.20	15,993	1,266,350	1,222,028				
Gravity concentration (tables)	100	24		18	10,899	10,572				
	87,415	5,013	180.46	21,679	1,283,671	1,237,683	905,356	852,506	2,383,815	2,083,632

Gross metal content of Washington concentrates produced, 1928 and 1929, by classes of concentrates

Class of concentrates	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
1928	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Copper	1,748	105.00	10,162	1,117,199		
Lead [1]	[1] 6	.32	[1] 143		[1] 6,111	(1)
Zinc	[1] 62		[1] 41		[1] 268	[1] 68,093
Copper-lead	70	1.00	721	13,809	57,984	
	1,886	106.32	11,067	1,131,008	64,363	68,093
1929						
Copper	1,878	172.20	16,011	1,277,249		
Lead	817	.26	3,909	1,495	773,585	
Zinc	2,245		520	4,000	122,396	2,317,819
Lead-zinc	73	8.00	1,239	927	9,375	65,996
	5,013	180.46	21,679	1,283,671	905,356	2,383,815

[1] Revised figures.

Mine production of metals from Washington concentrates in 1929, in terms of recovered metals

BY COUNTIES

	Ore to concentrating mills	Concentrates and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Pend Oreille	50,920	2,835	8.00	2,250	4,762	655,958	2,061,574
Snohomish	33,347	1,854	172.20	15,993	1,222,028		
Stevens	3,148	324	.26	3,436	10,893	196,548	22,058
	87,415	5,013	180.46	21,679	1,237,683	852,506	2,083,632
Total, 1928	29,318	1,886	106.32	11,067	1,094,730	61,146	62,662

BY CLASSES OF CONCENTRATES

Copper	1,878	172.20	16,011	1,232,600		
Lead	817	.26	3,909	1,047	734,905	
Zinc	2,245		520	3,600	110,181	2,027,981
Lead-zinc	73	8.00	1,239	436	7,420	55,651

Most of the crude ore shipped to smelters was copper ore from Stevens and Snohomish Counties and gold ore from Ferry County. The output of first-class gold ore from Ferry County, as well as first-class lead ore from Stevens County, decreased considerably.

Gross metal content of Washington crude ore shipped to smelters, 1928 and 1929, by classes of ore

Class of ore	Quantity (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
1928	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	29,075	12,560.65	69,988	201	2,010	
Copper	331	12.00	12,775	84,185		
Lead	[1]904	[1]2.68	[1]5,675	[1]1,190	[1]1,065,388	
Lead-zinc	[1]45	(1)	(1)	(1)	[1]12,140	28,320
	30,355	12,575.33	88,438	85,576	1,079,538	28,320
1929						
Dry and siliceous	467	548.01	6,789	346	1,845	
Copper	698	17.00	16,366	166,154		
Lead	176	1.84	2,107	1,959	151,650	
Lead-zinc	76				24,560	42,140
	1,417	566.85	25,262	168,459	178,055	42,140

[1] Revised figures.

Mine production of metals from Washington crude ore shipped to smelters, 1928 and 1929, in terms of recovered metals

1928

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ferry	28,978	12,519.34	65,198			
Okanogan	38	37.73	183		46	
Pierce	12		17	1,552		
Skagit	5	.11	56	34	1,281	
Snohomish	196	9.00	861	45,779		
Stevens	1,126	9.15	22,123	35,151	1,022,266	22,656
	30,355	12,575.33	88,438	82,516	1,023,593	22,656
BY CLASSES OF ORE						
Dry and siliceous	29,075	12,560.65	69,988	121	1,911	
Copper	331	12.00	12,775	81,659		
Lead	[1]904	[1]2.68	[1]5,675	[1]736	[1]1,011,970	
Lead-zinc	[1]45	(1)	(1)	(1)	[1]9,712	22,656

1929

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
Chelan	32	1.00	316	4,654		
Ferry	382	510.42	3,628	1,167	7,015	
Kittitas	12	3.00	491	55	402	
Okanogan	2		4	426		
Skamania	76		40	6,711		
Snohomish	261	12.00	1,621	74,010		
Stevens	648	40.43	19,162	75,210	155,267	33,712
Yakima	4			573		
	1,417	566.85	25,262	162,806	162,684	33,712
BY CLASSES OF ORE						
Dry and siliceous	467	548.01	6,789	261	1,425	
Copper	698	17.00	16,366	161,169		
Lead	176	1.84	2,107	1,376	144,067	
Lead-zinc	76				17,192	33,712

[1] Revised figures.

REVIEW BY COUNTIES AND DISTRICTS

CHELAN COUNTY

Chelan Lake district.—In June the Howe Sound Co. took charge of the Holden copper property, where considerable development has been done.

Leavenworth district.—Development of importance was continued at the property of the Royal Development Co., north of Leavenworth. About 2,500 feet of work was done in 1929 in drifts, raises, and crosscuts, and a car of copper ore was shipped to Tacoma as a test. In June, 1929, 80 men were employed, the mine railroad had been electrified, and some of the ore cut by the Trinity tunnel was said to average 8 per cent of copper. Sufficient ore has been developed to warrant the erection of a flotation mill; construction was begun early in 1930.

FERRY COUNTY

Curlew district.—One car of lead ore containing silver and copper was shipped from the Boston & New York property, now called the Welcome group.

Keller district.—A small lot of silver-lead ore was shipped from the Iron Creek property, which is being developed by the Shamrock Silver-Lead Mines (Inc.). About 300 feet of development was done in 1929 and early in 1930 the company started to sink a double-compartment shaft to a depth of 400 feet. A 300-foot tunnel was driven on the Inspiration-Henderson group on Silver Creek, and milling ore was being opened at the Pacific Mutual property.

Republic district.—In 1929 two lode mines in the Republic district produced 351 tons of ore, yielding $10,541 in gold and 3,035 ounces of silver, valued together at $12,159, or $34.64 in metals a ton. In 1928 the Republic district produced 28,978 tons of ore, which yielded $258,798 in gold and 65,198 ounces of silver, valued together at $296,939. The marked decrease in the output of the district in 1929 was due to the fact that no siliceous ore was purchased from the district by the Consolidated Mining & Smelting Co. of Canada (Ltd.), Trail, British Columbia. From 1896 to the end of 1929 the district produced 704,265 tons of ore and old tailings, yielding $8,647,157 in gold and 2,573,658 ounces of silver, valued together at $10,265,166. The output in 1929 was the smallest in years and consisted chiefly of about 300 tons of siliceous gold ore of good grade, mined by lessees from the Old Republic property, owned by Ferry County. The ledge, however, was not large, and the lease was relinquished. A small lot of gold ore was also shipped from the California property, 10 miles east of Republic. The other mines in the district, such as the Surprise-Lone Pine-Pearl group and the Quilp mine, were practically idle. More than 700 feet of development was done at the Last Chance property, formerly an important gold producer of the district, but no shipments have been made since 1928.

GARFIELD COUNTY

No output of note was reported from mines in Garfield County, but a small quantity of rich gold ore from the Alberta property in the Marshall Lake district near Pomeroy was crushed and amalgamated.

KITTITAS COUNTY

Cle Elum district.—One small lot of siliceous silver ore was shipped as a test from the property of the Camp Creek Mining & Milling Co. near Cle Elum.

Swauk district.—Two placers in the Swauk district produced gold valued at $6,011 and 98 ounces of silver. A prospector also cleaned up a small quantity of placer gold on Swauk Creek. The Kittitas Gold Mining Co., owning placer property on Swauk and Williams Creeks, operated its electric dredge from January to July; the dredge has a capacity of 5,000 cubic yards a day. The output of gold, which was valued at more than $5,900, was sent to the Seattle assay office. The Livingston Placer Mines (Inc.) installed hydraulic equipment on Swauk Creek and worked from September 9 to December 8, 1929. The company handled about 24,000 yards of bench gravel, using electric giants. No clean-up was made, however, owing to early freezing.

OKANOGAN COUNTY

Palmer Mountain district.—Aside from one small lot of sulphide copper ore produced from a prospect near Oroville, work in the Palmer Mountain district consisted of exploration. The General Metals Corporation (Ltd.) did about 400 feet of development at the Kaaba property at Nighthawk. The old 100-ton concentration plant on the property was idle, but the company was planning to add modern milling machinery.

Similkameen district.—The Slate Rock placer near Oroville was operated a short time, and a litte gold bullion was sent to the Denver mint. Diamond drilling was said to have cut ore at a depth of 280 feet at the Triumph property, 10 miles northwest of Oroville.

Squaw Creek district.—The China Bar placer, 2 miles south of Pateros on the Columbia River, was operated from July to December, 1929, but only a small sample of gold was recovered. Gold ore was being developed in a 400-foot tunnel at the Squaw Creek property at Methow, and both gold ore and copper ore were opened from a 700-foot tunnel at the Roosevelt mine.

PEND OREILLE COUNTY

The value of the metal output of Pend Oreille County increased from $5,229 in 1928 to $179,592 in 1929, the result of milling operations on lead-zinc ore by the Grandview Mines (Inc.) at Metaline Falls.

Metaline district (*Metaline Falls*).—In 1929 two lode mines in the Metaline district produced 50,920 tons of lead-zinc ore, yielding $166 in gold, 2,250 ounces of silver, 4,762 pounds of copper, 655,958 pounds of lead, and 2,061,574 pounds of zinc, valued in all at $179,592, or $3.53 in metals a ton. Nearly all the ore came from the Grandview mine and was milled in the company's new 200-ton flotation plant. The mine is developed by 2,000 feet of tunnels and drifts; $45,000 was spent for development in 1929. The entrance to the adit tunnel is unusually large (8 by 9 feet), and the property is equipped with a modern flotation plant which was moved from

Arizona. The mill began operating in March and during the remainder of the year treated more than 50,000 tons of lead-zinc ore containing chiefly zinc; about 2,800 tons of combined lead and zinc concentrates were shipped to the smelter and electrolytic plants near Kellogg, Idaho. The mill consists of two buildings, the larger one for fine-grinding and flotation machinery and the other for coarse crushing. The larger building is equipped with an overhead crane for conveniently installing and moving machinery, and contains a ball mill, Dorr classifier, flotation machines, and filters. A large quantity of lead-zinc ore, locally estimated at 1,000,000 tons, is said to be in reserve. The property was the largest producer of lead and zinc in Washington in 1929.

Interesting work was done at the Josephine, Hortense, Oriole, Sullivan, and Yellow Head groups belonging to the Pend Oreille Lead & Zinc Co., later changed to the Pend Oreille Mines & Metals Corporation. No output was reported from this property, but two cars of zinc concentrates remaining from former operations of the old mill were shipped to the electrolytic plant at Anaconda, Mont. Reserves of lead-zinc ore at this property were said to have been considerably increased by the development done in 1929, which consisted of 2,817 feet of drifts, more than 27,000 feet of churn drilling, and 7,834 feet of diamond drilling. Late in the year work was begun on the Cascade tunnel, which will cut the Josephine workings at a depth of 450 feet. No construction work was actually started on the proposed new mill or electrolytic zinc plant, but early in 1930 a new office building and a large modern hotel were under construction at Metaline Falls, and the construction of a new power plant was completed near the entrance to the Cascade tunnel. Continuous development done in 1928 and 1929 is reported to have opened about 250,000 tons of lead-zinc ore of milling grade at the Bella May and Blue Bucket claims.

PIERCE COUNTY

The American Smelting & Refining Co. operated its copper smelter and refinery at Tacoma, although only a comparatively small quantity of concentrates was shipped to the plant from mines in Washington. As in the past, the charge came chiefly from mines in Alaska, Canada, and South America. The smelter formerly received copper ore and concentrates from Chewelah, but in 1929 the output was limited to occasional shipments by lessees. Other receipts from Washington consisted chiefly of copper concentrates from the Sunset mine near Index.

SKAGIT COUNTY

Development of ore containing gold, silver, copper, lead, and molybdenum was continued at the Thunder Creek property on Summit Fork of Thunder Creek.

SKAMANIA COUNTY

St. Helens district.—Three cars of low-grade copper ore from the St. Helens property in Paradise Gulch near Spirit Lake were shipped for testing purposes. The property is opened by several tunnels aggregating 2,850 feet, and the adit was cleaned and retimbered in 1929.

SNOHOMISH COUNTY

Darrington district.—Copper ore is being developed at the Boston property near Darrington by the Jumbo Copper Mining Co.

Index district.—The Sunset Copper Co. near Index was by far the largest producer of copper in Washington; it was also the largest producer of silver. The mill, a 150-ton concentration plant equipped with crushers, rolls, tables, and flotation machines, treated more than 33,000 tons of ore in 1929, but it was not operated full time owing to extremely cold weather early in the year and to insufficient power due to low water in September. The mine is opened by a 600-foot adit tunnel and drifts on five levels above and below the adit, as well as by a 200-foot vertical shaft to the lower levels and 2,000 feet of crosscutting to other veins. In 1929 more than 700 feet of drifting, crosscutting, and sinking was done. Copper concentrates are shipped by a 7-mile logging railroad to Index, where they are transferred to the Great Northern Railway for delivery to Tacoma.

Sampson (Glacier Peak) district.—The Glacier Peak Mining & Smelting Co. spent several months developing its copper property near Lucerne.

STEVENS COUNTY

The value of the production of metals in Stevens County was $53,885 in 1929, or $35,511 less than that in 1928. This large decrease was due to the fact that the Gladstone Mountain mine near Northport was virtually idle.

Aladdin district.—A small lot of silver-lead ore was shipped from the Morning mine, 20 miles from Northport on the Great Northern Railway.

Bossburg district.—Several thousand tons of lead ore from the Bonanza dump near Bossburg was treated in a small flotation plant, and more than 200 tons of concentrates containing about 8 ounces of silver to the ton and 37 per cent of lead was shipped to Bradley, Idaho, for smelting. Ore from the mine was formerly jigged and tabled, but new equipment consists of a 4-foot ball mill, classifier, flotation machines, and a Dorr thickener. No development was done at the property in 1929.

Chewelah district.—The output of the United Copper property, owned by the Chewelah Union Mining Co., consisted of about five cars of copper ore containing considerable silver. The company did no work in 1929, but part of the mine was worked by lessees. The ore contains chalcopyrite and tetrahedrite and the mine, which is 6 miles northeast of Chewelah, close to the highway between Chewelah and Colville, was a large producer of copper and silver from these minerals from 1912 to 1923. The Enterprise Mining Co. operated the Hygrade property and opened rich copper-lead ore containing much silver.

Colville and Clugsten Creek district.—Three lode mines in the Colville region produced 59 tons of ore, yielding $21 in gold, 3,014 ounces of silver, 10 pounds of copper, 11,881 pounds of lead, and 22,058 pounds of zinc, valued in all at $3,834, or $64.98 in metals a ton. A car of lead-zinc ore from the Old Dominion mine, a large producer of silver and lead in 1925, was shipped to a custom mill at Wallace, Idaho, for testing. A test lot of lead-zinc ore was also shipped from the Middleport mine, 3 miles northwest of Middleport, and a small quantity of high-grade silver ore from the Chloride Queen property was shipped to Tacoma for smelting. Development was done at the Easy Money, New Leadville, and Silver Chief groups.

Kettle Falls district.—The Silver Queen group near Kettle Falls was under development from April to December.

Loon Lake district.—The Loon Lake copper property north of Spokane was reopened and operated by the Loon Lake Copper-Silver Corporation.

Northport district.—In 1929 five lode mines in the Northport district produced 204 tons of ore, yielding $1 in gold, 169 ounces of silver, 94 pounds of copper, 151,725 pounds of lead, and 33,712 pounds of zinc, valued in all at $11,891, or $58.29 in metals a ton. The entire output was first-class smelting ore, chiefly lead ore from the Electric Point mine and lead-zinc ore from the Great Western property. In 1928 nine lode mines produced 1,284 tons of ore, which yielded metals valued at $65,490. From 1923 to 1928 the Gladstone Mountain property was the largest producer of lead in Washington, but since 1927 marked curtailment in shipments of lead ore from the property has seriously decreased the value of the district output. Lessees worked the Electric Point mine and shipped several cars of lead ore to Bradley, Idaho, for smelting. The Gladstone Mountain property, formerly a large producer of lead ore, was optioned by the Northport Power & Light Co. Exploration by diamond drilling was done in May, but the work proved unsatisfactory and was suspended. Two cars of oxidized lead-zinc ore from the Great Western group, under lease, were shipped to a zinc smelter in Wisconsin, and small test lots of lead ore were shipped from prospects near Northport. Considerable trenching was done at the Keystone property on Gladstone Mountain.

Orient district.—The Acme Consolidated Mines (Inc.) worked the F. H. & C. group on Sand Creek, 8 miles northeast of Orient, and shipped two cars of first-class smelting ore to Bradley, Idaho; the ore contains chiefly gold, which occurs as sylvanite. The property is opened by a vertical shaft 180 feet deep and 250 feet of drifts; in 1929 about $5,000 was spent for development. Other metal output from this district was iron ore, which was shipped from the Big Iron property to Chewelah for use at the magnesite plant.

Springdale (Cedar Canyon) district.—Four lode mines in the Springdale district produced 295 tons of ore, yielding $31 in gold, 3,226 ounces of silver, 43,931 pounds of copper, and 2,492 pounds of lead, valued in all at $9,639, or $32.67 in metals a ton. Most of the output was copper ore from the Turk and Togo mines near Fruitland. The Snowdrift Mining Co. worked the Turk mine part of the year and shipped several cars of copper ore to Tacoma for smelting. The company also treated about 100 tons of copper ore in a small gravity-concentration plant. The mine is said to have a body of copper ore of good grade, which occurs as chalcopyrite. Later in the year the property was operated by the Columbia River Copper Co., and plans were made for development at depth and for building a flotation plant. Two cars of copper ore were shipped from the Togo mine by the Togo Copper Co., but later the mine was returned to the original owner, the Consolidated Copper Co. The remainder of the district output consisted of one car of rich silver ore from the Silver

Queen property of the Commodore Mines Corporation and a car of sulphide lead ore rich in silver from the Venus Silver property. About 340 feet of drifting and raising was done at the Venus property by the Mining Corporation of America, but the 100-ton mill designed for flotation and cyanidation was not completed. The Deertrail Monitor Mines Co. did 500 feet of tunnel work on the Monitor group near Fruitland.

Summit district.—The Consolidated Silver Mountain Mines Co. owns a mill and fuming plant northwest of Addie on the Great Northern Railway, but no products were marketed in 1929.

Valley district.—Work at the Admiral property near Valley consisted of 300 feet of crosscutting.

WHATCOM COUNTY

Mount Baker district (*Sumas*).—The Boundary Red Mountain mine south of Sardis, British Columbia, was operated under lease in 1929, as it was in 1928. About 4,700 tons of gold ore was treated in a 10-stamp amalgamation mill from March 1 to December 10, but the gold recovered was slightly less than the output of 1928. The mine was operated from February to the end of the year, although no statement was made regarding the quantity of development done. Supplies for operations are hauled by pack mules from Sardis, British Columbia, a distance of 35 miles.

Slate Creek district.—Development was resumed at the Azurite gold property near Twisp.

YAKIMA COUNTY

A small lot of copper ore was shipped from a prospect near Bumping Lake.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA [1]

(MINE REPORT)

By V. C. Heikes [2]

SUMMARY

The output of gold, silver, copper, and lead from California mines in 1929 was valued at $15,090,589, a decrease of 2 per cent, compared with 1928. The quantity and value of each metal except copper decreased. Gold decreased 21 per cent, silver 20 per cent in quantity and 27 per cent in value, and lead 24 per cent in quantity and 18 per cent in value. The production of copper increased 32 per cent in quantity and 61 per cent in value, compared with 1928. No zinc was reported produced in the State in 1929 or 1928.

The value of the metals produced from 324 lode mines in 1929 was $11,212,887, an increase of 7 per cent, compared with the output of 287 lode mines in 1928. Gold produced at lode mines in 1929 ($4,656,096) was 22 per cent less than in 1928, and silver (1,163,583 ounces, valued at $620,190) was 20 per cent less in quantity and 27 per cent less in value. The quantity of ore, tailings, etc., from lode mines in 1929 was 1,657,069 short tons, or 3 per cent less than in 1928.

The total value of gold and silver produced by 478 placer mines in California in 1929 was $3,877,702, or 20 per cent less than the output of 460 placer mines in 1928. The placer gold production was $3,870,607, or 20 per cent less than in 1928. The quantity of silver recovered at placer mines in 1929 was 13,312 ounces, valued at $7,095, a decrease of 23 per cent in quantity and 30 per cent in value, compared with 1928. The placer output of gold and silver was from the operations of 25 dredges, 65 drift mines, 103 hydraulic mines, and 285 surface mines.

The total value of gold, silver, copper, lead, and zinc produced from California ores and gravels from 1848 to 1929, inclusive, is recorded by the Bureau of Mines as $2,106,715,447.

The figures by decades are given in the following table. For details by years through 1926 the reader is referred to the report[3] by J. M. Hill, published in 1929.

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[1] Work on manuscript completed November, 1930.

[2] Helen M. Gaylord, of the Bureau of Mines, prepared the statistics for this report.

[3] Hill, J. M., Historical Summary of Gold, Silver, Copper, Lead, and Zinc Produced in California, 1848 to 1926: Econ. Paper 3, Bureau of Mines, 1929.

Gold, silver, copper, lead, and zinc in California, 1848–1929, by decades

Decade	Gold [1]			Silver [2]	
	Placer	Lode	Total	Fine ounces	Value
1848–1850	$51,669,767	----------	$51,669,767	353,000	$465,960
1851–1860	581,561,868	$5,874,362	587.436,230	4,017,000	5,402,865
1861–1870	211,388,439	23,487,604	234,876,043	1,755,000	2,342,925
1871–1880	120,910,077	51,818,604	172,728,681	6,152,000	7,530,048
1881–1890	37,881,328	113,643,986	151,525,314	12,899,017	13,540,200
1891–1900	29,416,001	117,664,005	147,080,006	6,012,310	4,139,070
1901–1910	63.569,813	118,337,674	181,907,487	12,848,365	7,372,497
1911–1920	84,739,988	107,249,344	191,989,332	15,680,607	11,648,499
1921–1929	49,648,730	63,227,473	112,876,203	23,196,648	17,822,793
	1,230,786,011	601,303,052	1,832,089,063	82,913,947	70,264,857

Decade	Copper [3]		Lead [4]		Zinc [5]		Total value [6]
	Pounds	Value	Pounds	Value	Pounds	Value	
1848–1850	----------	----------	----------	----------	----------	----------	$52,135,727
1851–1860	----------	----------	----------	----------	----------	----------	592,839,095
1861–1870	19,130,000	$6,681,810	----------	----------	----------	----------	243,900,778
1871–1880	4,132,000	936,232	65,214,000	$3,531,370	----------	----------	184,726,331
1881–1890	8,047,834	1,234,010	24,480,000	1,088,300	----------	----------	167,387,824
1891–1900	91,293,128	13,669,971	10,013,900	375,085	----------	----------	165,264,132
1901–1910	325,162,456	47,553,335	10,327,122	477,678	439,550	$26,345	237,337,342
1911–1920	361,685,828	71,644,845	70,918,299	4,910,542	55,022,707	5,950.996	286,144,214
1921–1929	280,541,776	39,909,253	42,448,551	3,037,076	46,904,883	3,334,679	176,980,004
	1,089,993,022	181,629,456	223,401,872	13,420,051	102,367,140	9,312,020	2,106,715,447

[1] Gold figures, 1848–1883, from table compiled by C. G. Yale and published in 13th Ann. Rept. of the California State Mineralogist; figures, 1884-1902, from mint agents' statements in the annual reports of the Director of the Mint; figures, 1902 to date, from annual chapters, Gold, Silver, Copper, Lead, and Zinc in California, published in Mineral Resources of the United States.

[2] Silver figures, 1848–1880, by decades, estimated by J. M. Hill (see discussion "Sources of silver production"); figures, 1891–1903, from mint agents' statements in the annual reports of the Director of the Mint (ounces and value calculated from original figures given as coinage value); figures, 1904 to date, from annual chapters, Gold, Silver, Copper, Lead, and Zinc in California, published in Mineral Resources of the United States.

[3] Copper figures, 1862–1904, from chapter on Copper in Mineral Resources of the United States, 1915, Pt. I, p. 663; figures, 1905 to date, from annual chapters, Gold, Silver, Copper, Lead, and Zinc in California, published in Mineral Resources of the United States.

[4] Lead figures, 1870–1876, estimated by J. M. Hill from various data; figures, 1877–1881, from chapter on Lead in Mineral Resources of the United States, 1912, Pt. I, p. 339; figures, 1882–1886, from annual chapters on Lead in Mineral Resources volumes; figures, 1887–1903, from 18th Ann. Rept. of the California State Mineralogist, p. 451; figures, 1904 to date, from annual chapters, Gold, Silver, Copper, Lead, and Zinc in California, published in Mineral Resources of the United States.

[5] Zinc figures from annual chapters, Gold, Silver, Copper, Lead, and Zinc in California, published in Mineral Resources of the United States.

[6] Value of gold, $20.671835 a fine ounce. Value of other metals calculated from price table published in preface to the Metals volumes (Pt. I) of Mineral Resources of the United States.

The value of metal production herein reported for 1920 to 1929 has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1920 to 1922 is New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1920	$1.09	$0.184	$0.080	$0.081	1925	$0.694	$0.142	$0.087	$0.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064
1923	.82	.147	.070	.068	1928	.585	.144	.058	.061
1924	.67	.131	.080	.065	1929	.533	.176	.063	.066

Mine production of gold, silver, copper, lead, and zinc in California, 1920-1929, in terms of recovered metals

Year	Mines producing		Ore, tailings, etc. (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1920	301	199	1, 165, 022	692, 296. 70	$14, 311, 043	1, 706, 327	$1, 859, 896
1921	294	279	1, 215, 600	759, 720. 76	15, 704, 822	3, 629, 223	3, 629, 223
1922	283	282	1, 539, 933	709, 677. 99	14, 670, 346	3, 100, 065	3, 100, 065
1923	268	353	1, 535, 691	647, 209. 75	13, 379, 013	3, 559, 443	2, 918, 743
1924	267	266	2, 019, 200	636, 139. 72	13, 150, 175	3, 555, 133	2, 381, 939
1925	332	359	1, 938, 679	632, 035. 31	13, 065, 330	3, 054, 416	2, 119, 765
1926	335	483	1, 760, 859	576, 798. 40	11, 923, 481	2, 022, 460	1, 262, 015
1927	318	465	1, 526, 410	564, 585. 50	11, 671, 018	1, 620, 242	918, 677
1928	287	460	1, 702, 541	521, 739. 59	10, 785, 315	1, 478, 771	865, 081
1929	324	478	1, 657, 069	412, 479. 25	8, 526, 703	1, 176, 895	627, 285

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1920	12, 626, 272	$2, 323, 234	4, 813, 510	$385, 081	1, 165, 509	$94, 406	$18, 973, 660
1921	11, 743, 404	1, 514, 899	1, 124, 276	50, 592	846, 184	42, 309	20, 941, 845
1922	22, 539, 485	3, 042, 830	6, 312, 536	347, 189	3, 012, 950	171, 738	21, 332, 168
1923	28, 317, 759	4, 162, 711	9, 549, 680	668, 478	------------	------------	21, 128, 945
1924	52, 107, 171	6, 826, 039	4, 763, 806	381, 104	3, 060, 000	198, 900	22, 938, 157
1925	46, 864, 913	6, 654, 818	6, 566, 200	571, 259	11, 489, 237	873, 182	23, 284, 354
1926	33, 466, 299	4, 685, 282	8, 093, 513	647, 481	20, 433, 887	1, 532, 542	20, 050, 801
1927	27, 133, 008	3, 554, 424	2, 718, 014	171, 235	8, 062, 625	516, 008	16, 831, 362
1928	25, 150, 743	3, 621, 707	1, 891, 037	109, 680	------------	------------	15, 381, 783
1929	33, 218, 994	5, 846, 543	1, 429, 489	90, 058	------------	------------	15, 090, 589

Gold and silver produced at placer mines in California, 1920–1929

Year	Dredge				Drift			
	Gold		Silver		Gold		Silver	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
1920	333, 805. 20	$6, 900, 366	28, 918	$31, 521	3, 044. 00	$62, 925	374	$408
1921	375, 234. 56	7, 756, 787	36, 322	36, 322	6, 163. 51	127, 411	615	615
1922	241, 837. 04	4, 999, 215	16, 608	16, 608	12, 220. 79	252, 626	1, 391	1, 391
1923	293, 429. 92	6, 065, 735	17, 569	14, 407	8, 938. 31	184, 771	955	783
1924	208, 279. 59	4, 305, 521	14, 793	9, 911	4, 768. 22	98, 568	560	375
1925	229, 821. 98	4, 750, 842	16, 478	11, 436	3, 218. 07	66, 523	358	248
1926	239, 482. 59	4, 950, 545	17, 287	10, 787	5, 381. 06	111, 236	942	588
1927	264, 220. 81	5, 461, 929	18, 530	10, 507	6, 865. 82	141, 929	835	473
1928	214, 345. 43	4, 430, 913	14, 510	8, 488	7, 420. 05	153, 386	799	467
1929	173, 630. 38	3, 589, 259	11, 510	6, 135	4, 095. 82	84, 668	450	240

Gold and silver produced at placer mines in California, 1920–1929—Continued

Year	Hydraulic				Surface				Total value
	Gold		Silver		Gold		Silver		
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	
1920	3,204.02	$66,233	413	$450	1,503.93	$31,089	195	$212	$7,093,204
1921	7,875.84	162,808	864	864	5,215.70	107,818	829	829	8,193,454
1922	7,656.57	158,275	906	906	4,341.10	89,739	708	708	5,519,468
1923	5,409.68	111,828	626	513	7,752.06	160,249	1,155	947	6,539,233
1924	2,911.93	60,195	409	274	6,002.77	124,088	928	622	4,599,554
1925	8,482.30	175,345	958	665	5,003.61	103,434	785	545	5,109,038
1926	3,344.62	69,139	450	281	4,715.72	97,483	683	426	5,240,485
1927	5,845.25	120,832	700	397	5,448.14	112,623	838	475	5,849,165
1928	4,426.90	91,512	538	315	8,456.80	174,818	1,364	798	4,860,697
1929	2,889.55	59,732	445	237	6,624.85	136,948	907	483	3,877,702

GOLD

The mine production of gold in California in 1929 was $8,526,703, $2,258,612 less than the output in 1928 and the greatest annual decrease since that of 1920 compared with 1919. In only one year (1921) in the decade 1920 to 1929 did the production of gold increase. In 1929 the lode and placer mines shared the decrease about equally, whereas in 1928 the placers, mostly dredges, showed the larger decrease. In 1929, for the first time since the beginning of gold mining in California in 1848, the value of the gold output fell below $10,000,000; it was lower than that recorded for any year except 1848, when the output was valued at $245,301.

For the decade 1920 to 1929 four counties—Amador, Nevada, Sacramento, and Yuba—each produced annually more than $1,000,000 in gold, and these counties have led in gold output except in 1922 when Sacramento County ranked sixth and in 1925 when it ranked fifth. Yuba County, one of the chief gold-dredging fields of the State, ranked first in the output of gold except in 1922, 1924, and 1929, when Nevada County, with its gold chiefly from lode mining, ranked first.

The output of placer gold in 1929 was $3,870,607. Dredges produced 93 per cent (91 per cent in 1928); surface mines, 3 per cent; drift mines, 2 per cent; and hydraulic mines, 2 per cent. Twenty-five dredges operated in 1929 (24 in 1928) and produced 19 per cent less gold than in the preceding year; the production came from gravel worked in Sacramento, Yuba, Trinity, Stanislaus, Merced, Shasta, Butte, Amador, and Calaveras Counties, named in order of output. As the output of gold from dredges in Yuba County decreased to $848,804 and as only four boats were working in this field at the end of the year instead of six as in 1928, the trend of the gold-dredging industry in California does not promise increased output. Two new dredges, one in Calaveras County and one in Trinity County, were placed in operation, but the output by these new dredges and by the additional dredge in Butte County did not materially affect the output of gold from dredging. The Butte County dredge was a small experimental one and made only a test run.

The chief lode gold-producing counties of the State, named in order of production in 1929, were: Nevada, Amador, Plumas, Sierra, Kern, Mariposa, Calaveras, Tuolumne, San Bernardino, and Eldorado. Of these counties Plumas and Tuolumne were the only ones to increase their output in 1929.

Gold ore and tailings sold or treated in 1929 yielded 90 per cent; copper ore, tailings, etc., 9 per cent; and silver ore 1 per cent of the total gold from lode mines. Amalgamation mills in 1929 recovered 71 per cent, cyanidation plants 14 per cent, and smelters 15 per cent of the lode gold output of California, compared with 74 per cent, 16 per cent, and 10 per cent, respectively, in 1928. The ore amalgamated (503,167 tons) averaged $6.57 in recovered gold and 0.08 ounce of silver to the ton.

Pocket mining in 1929 contributed 10,585.04 ounces, or 5 per cent, to the total lode gold output of the State. Most of this gold was recovered by hand mortar and panning from rich pocket material and specimens. Counties in which pocket mining was reported were Amador, Butte, Calaveras, Eldorado, Mariposa, Nevada, Shasta, Sierra, Siskiyou, and Tuolumne.

In 1929, as in 1928, 26 companies in the State produced more than 1,000 ounces of gold each and contributed nearly 90 per cent of the total gold output of the State. Of the 26 larger companies 5 produced more than 20,000 ounces each and 3 more than 50,000 ounces each; 8 of them operated 21 dredges, 1 operated a silver mine, 2 operated copper mines, 15 operated gold lode mines, and 1 operated a plant treating tailings containing gold. The 10 largest gold-producing companies in California in 1929, in order of output, were the Yuba Consolidated Gold Fields (6 dredges), Empire Star Mines Co. (Ltd.) (gold lode), Natomas Co. (6 dredges), Argonaut Mining Co. (gold lode), Central Eureka Mining Co. (gold lode), Kennedy Mining & Milling Co. (gold lode), Walker Mining Co. (copper mine), Original Sixteen to One Mines (Inc.) (gold lode), Capital Dredging Co. (2 dredges), and the Trinity Dredging Co. (1 dredge).

SILVER

The mine production of silver in California in 1929 was 1,176,895 ounces, valued at $627,285, a decrease of 301,876 ounces and of $237,796 compared with 1928. The leading silver-producing counties in 1929, in order of output, were Plumas, San Bernardino, Napa, Shasta, Mono, Inyo, and Nevada; their output ranged from a high production of 408,466 ounces to a low of 41,015 ounces. The two silver mines in the State reporting the largest production were the Kelly Rand or Uranium in San Bernardino County and the Palisades or Grigsby in Napa County. Six mines produced 25,160 tons of silver ore in 1929, which yielded 481,300 ounces of silver, or slightly more than 41 per cent of the total silver from lode mining. Copper ore, tailings, etc., yielded 547,183 ounces of silver, or 47 per cent of the total silver from lode mining; dry gold ore and tailings, more than 6 per cent; lead ore, more than 5 per cent; and lead-copper ore, a small quantity. Concentrates yielded 67 per cent of the silver; first-class smelting ore, 29 per cent; and bullion from amalgamation and cyanidation mills, 4 per cent of the total silver from lode mining.

Thirty-two companies in California produced 1,145,660 ounces of silver in 1929, or 97 per cent of the State output. No company produced more than 500,000 ounces of silver, only 4 produced more than 100,000 ounces each, 2 between 50,000 and 100,000 ounces, and 26 less than 50,000 ounces. The 10 largest silver-producing companies in California in 1929, in order of output, were the Consolidated Metals Corporation (Uranium or Kelly Rand), Walker Mining Co., Banner Development Co. (Palisades), Engels Copper Mining Co., Mountain Copper Co. (Ltd.), Comanche Mining & Reduction Co., Estelle Mines Corporation, Empire Star Mines Co. (Ltd.), Island Copper Co., and American Foundation Co.

COPPER

The mine production of copper in California in 1929 was 33,218,994 pounds, valued at $5,846,543, an increase of 8,068,251 pounds over 1928. This is the largest output of copper since 1926. Plumas County, with its two outstanding copper mines, produced 75 per cent (84 per cent in 1928), Shasta County 18 per cent (12 per cent in 1928), Calaveras County 4 per cent (less than 1 per cent in 1928), and Trinity County 2 per cent (3 per cent in 1928) of the total copper output of the State. The remainder of the copper came from miscellaneous mines in various counties. More copper mines were worked than in 1928 and added facilities in mining equipment inaugurated in 1928 resulted in greater production in 1929, but the end of 1929 found the principal copper companies curtailing production.

Thirty-six properties in 1929 (16 in 1928) produced 1,007,078 tons of copper ore, yielding 32,625,569 pounds of copper, or 98 per cent of the total copper yield of the State. Copper concentrates, recovered from 954,565 tons of ore, amounted to 62,220 tons and yielded 28,990,663 pounds of copper, or 87 per cent of the total. Crude ore of all kinds shipped to smelters yielded 11 per cent of the total copper. The remaining 2 per cent of the copper came from the smelting of cement copper obtained by leaching the residue from the roasting of pyrites for the manufacture of sulphuric acid and from the smelting of smelter cleanings, slag, and matte. The leading copper producers in California in 1929 were, in order of output, the Walker Mining Co. and the Engels Copper Mining Co., both in Plumas County; the Mountain Copper Co. (Ltd.) in Shasta County; the Calaveras Copper Co., a subsidiary of the Engels Copper Mining Co., in Calaveras County; and the Island Copper Co. in Trinity County.

The copper ore produced in the State in 1929 had an average assay content of 0.02 ounce of gold and 0.51 ounce of silver to the ton, and 1.59 per cent of copper.

LEAD

The mine production of lead in California in 1929 was 1,429,489 pounds, valued at $90,058, a decrease of 461,548 pounds or 24 per cent compared with 1928. Inyo, the chief lead-producing county, yielded 94 per cent, San Bernardino County 4 per cent, and Mono County 1 per cent of the total lead output of the State.

The principal lead producers in Inyo County were the Estelle and Cerro Gordo mines in the Cerro Gordo district, operated by the Estelle Mines Corporation; the Ophir mine in the Trona district; and the Santa Rosa mine in the Santa Rosa district. The Estelle mine produced more than 500,000 pounds of lead; 2 mines each produced between 100,000 and 200,000 pounds; and 14 mines each had an output of less than 100,000 pounds.

Lead ore yielded 98 per cent of the total lead recorded for California in 1929. Ore of all kinds sent to smelters yielded 96 per cent and concentrates 4 per cent of the entire output.

Thirty properties in California in 1929 produced 2,966 tons of lead ore, which had an average assay content of 0.12 ounce of gold and 20.44 ounces of silver to the ton, 0.35 per cent of copper, and 24.77 per cent of lead.

Mine production of gold, silver, copper, and lead in California in 1929, by counties, in terms of recovered metals

County	Mines producing		Gold					
			Lode		Placer		Total	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alameda	1							
Alpine	1							
Amador	17	17	74, 770. 81	$1, 545, 650	2, 719. 23	$56, 211	77, 490. 04	$1, 601, 861
Butte	4	43	79. 38	1, 641	3, 399. 62	70, 276	3, 479. 00	71, 917
Calaveras	29	24	3, 754. 33	77, 609	1, 269. 06	26, 234	5, 023. 39	103, 843
Del Norte	1							
Eldorado	17	26	2, 008. 27	41, 515	781. 99	16, 165	2, 790. 26	57, 680
Fresno, Merced, and Stanislaus	2	5	29. 42	608	10, 934. 04	226, 027	10, 963. 46	226, 635
Humboldt	1	5	10. 28	213	104. 46	2, 159	114. 74	2, 372
Imperial		1			49. 81	1, 030	49. 81	1, 030
Inyo	24		817. 01	16, 889			817. 01	16, 889
Kern	30	4	7, 146. 71	147, 736	33. 15	685	7, 179. 86	148, 421
Lassen	1		8. 11	168			8. 11	168
Los Angeles	2	2	9. 06	187	38. 88	804	47. 94	991
Madera	5	5	49. 34	1, 020	21. 98	454	71. 32	1, 474
Mariposa	19	12	4, 265. 29	88, 171	139. 37	2, 881	4, 404. 66	91, 052
Mono	9		484. 98	10, 025			484. 98	10, 025
Monterey	1		12. 70	263			12. 70	263
Napa	1		860. 16	17, 781			860. 16	17, 781
Nevada	13	34	85, 856. 74	1, 774, 816	1, 586. 56	32, 797	87, 443. 30	1, 807, 613
Orange	1		1. 38	29			1. 38	29
Placer	6	48	266. 21	5, 503	1, 411. 99	29, 188	1, 678. 20	34, 691
Plumas	9	30	18, 144. 65	375, 083	802. 99	16, 599	18, 947. 64	391, 682
Riverside	3		11. 81	244			11. 81	244
Sacramento		17			72, 179. 49	1, 492, 083	72, 179. 49	1, 492, 083
San Bernardino	33	3	2, 143. 27	44, 305	32. 85	679	2, 176. 12	44, 984
San Diego	3	1	13. 75	284	48. 27	998	62. 02	1, 282
San Luis Obispo		3			61. 27	1, 267	61. 27	1, 267
Shasta	11	30	1, 380. 06	28, 528	2, 958. 66	61, 161	4, 338. 72	89, 689
Sierra	14	26	17, 200. 22	355, 560	572. 56	11, 836	17, 772. 78	367, 396
Siskiyou	12	72	1, 030. 55	21, 303	2, 057. 87	42, 540	3, 088. 42	63, 843
Trinity	9	40	1, 212. 85	25, 072	15, 816. 54	326, 957	17, 029. 39	352, 029
Tuolumne	41	4	3, 344. 60	69, 139	87. 93	1, 818	3, 432. 53	70, 957
Ventura	1		22. 86	473			22. 86	473
Yuba	3	26	303. 85	6, 281	70, 132. 03	1, 449, 758	70, 435. 88	1, 456, 039
	324	478	225, 238. 65	4, 656, 096	187, 240. 60	3, 870, 607	412, 479. 25	8, 526, 703
Total, 1928	287	460	287, 090. 41	5, 934, 686	234, 649. 18	4, 850, 629	521, 739. 59	10, 785, 315

Mine production of gold, silver, copper, and lead in California in 1929, by counties, in terms of recovered metals—Continued

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alameda	104	$55			104	$55
Alpine						
Amador	17,306	9,224	315	$168	17,621	9,392
Butte	14	7	315	168	329	175
Calaveras	6,352	3,386	109	58	6,461	3,444
Del Norte	6	3			6	3
Eldorado	362	193	80	43	442	236
Fresno, Merced, and Stanislaus	50	27	1,092	582	1,142	609
Humboldt	154	82	35	19	189	101
Imperial			30	16	30	16
Inyo	43,544	23,209			43,544	23,209
Kern	4,328	2,307	9	5	4,337	2,312
Lassen	4	2			4	2
Los Angeles	58	31	6	3	64	34
Madera	886	472	5	3	891	475
Mariposa	1,189	634	32	17	1,221	651
Mono	52,791	28,138			52,791	28,138
Monterey	2	1			2	1
Napa	144,180	76,848			144,180	76,848
Nevada	40,804	21,749	211	112	41,015	21,861
Orange	839	447			839	447
Placer	49	26	201	107	250	133
Plumas	408,383	217,668	83	44	408,466	217,712
Riverside	1,468	782			1,468	782
Sacramento			2,886	1,538	2,886	1,538
San Bernardino	356,009	189,753	6	3	356,015	189,756
San Diego	7	4	2	1	9	5
San Luis Obispo			2	1	2	1
Shasta	57,849	30,834	402	214	58,251	31,048
Sierra	3,283	1,750	62	33	3,345	1,783
Siskiyou	1,263	673	356	190	1,619	863
Trinity	17,157	9,145	2,109	1,124	19,266	10,269
Tuolumne	5,121	2,729	11	6	5,132	2,735
Ventura	6	3			6	3
Yuba	15	8	4,953	2,640	4,968	2,648
	1,163,583	620,190	13,312	7,095	1,176,895	627,285
Total, 1928	1,461,560	855,013	17,211	10,068	1,478,771	865,081

County	Copper		Lead		Grand total value
	Pounds	Value	Pounds	Value	
Alameda	100,233	$17,641			$17,696
Alpine	7,260	1,278			1,278
Amador					1,611,253
Butte					72,092
Calaveras	1,190,782	209,578	8,270	$521	317,386
Del Norte	5,002	880			883
Eldorado					57,916
Fresno, Merced, and Stanislaus	2,100	370			227,614
Humboldt	64,552	11,361			13,834
Imperial					1,046
Inyo	17,547	3,088	1,339,876	84,412	127,598
Kern					150,733
Lassen					170
Los Angeles	1,981	349			1,374
Madera	19,135	3,368			5,317
Mariposa	6,298	1,108			92,811
Mono	16,752	2,948	19,685	1,240	42,351
Monterey					264
Napa	4,356	767	249	16	95,412
Nevada	5,655	995	6,664	420	1,830,889
Orange			1,471	93	569
Placer					34,824
Plumas	24,929,390	4,387,573			4,996,967

Mine production of gold, silver, copper, and lead in California in 1929, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Grand total value
	Pounds	Value	Pounds	Value	
Riverside	1,465	$258			$1,284
Sacramento					1,493,621
San Bernardino	80,551	14,177	52,958	$3,336	252,253
San Diego					1,287
San Luis Obispo					1,268
Shasta	6,033,624	1,061,918			1,182,655
Sierra					369,179
Siskiyou	34,349	6,045			70,751
Trinity	615,579	108,342			470,640
Tuolumne	82,383	14,499	316	20	88,211
Ventura					476
Yuba					1,458,687
	33,218,994	5,846,543	1,429,489	90,058	15,090,589
Total, 1928	25,150,743	3,621,707	1,891,037	109,680	15,381,783

MINING INDUSTRY

Mining in California in 1929 was marked by several interesting features, one of which particularly attracted interest to the gold-mining industry, namely, the merging of the Empire mine near Nevada City with the North Star mine near Grass Valley. As a result of this merger a new company, the Empire Star Mines Co. (Ltd.), was formed to operate the properties under the management of the Newmont Mining Co. Both mines have long been large and consistent producers of gold and have placed Nevada County among the leading gold-producing counties in the State.

The American Smelting & Refining Co. directed attention to lead mining in the Cerro Gordo district in Inyo County by its exploration and development of the Estelle and Cerro Gordo mines. The Mountain Copper Co. (Ltd.) in Shasta County carried out extensive plans for mining and milling ores from its property and greatly increased its output. In Plumas County the copper property of the Walker Mining Co. reached the point where it could pay dividends; the Engels Copper Mining Co., according to its annual printed report, did not reveal a particularly gratifying earning position. Further interest was developed in Napa County by the favorable working of the old Palisades silver mine; the ores from this mine were treated by flotation. Much exploratory work was done at this mine; it led to the development of new ore bodies that carried silver and increasing quantities of gold.

An act that aided the small gold operator in the mountain districts was the amendment to the ore buyers license act, effective August 14, which provided for annual license fees of only $2, with no bond, for purchases of gold amounting to less than $1,000 annually and of $15, with no bond, for amounts exceeding $1,000 annually. Gold is purchased from prospectors by dealers who report to the State Mineralogist each lot purchased and who dispose of the gold so purchased when the amount reaches $100 or more. Less than $100 in bullion is not accepted at the United States mint.

Lode mining yielded 1,657,069 tons of ore in 1929 from mines and prospects operated by 324 companies and individuals. The largest producer was a copper property in Plumas County, which yielded nearly 500,000 tons of ore. Of the gold lode mines none produced more than 170,000 tons of ore; the largest producer of gold ore was in Nevada County and was followed by 3 mines in Amador County, each of which produced between 50,000 and 90,000 tons. One mine in Sierra County produced nearly 40,000 tons of gold ore. San Bernardino County was the largest producer of silver ore; the output was nearly 16,000 tons. Inyo County was the largest producer of lead ore; most of it came from one mine, which yielded about 1,200 tons. The six counties mentioned, having within their borders eight of the largest producing lode mines of California, accounted for about 82 per cent of the total ore and tailings and 81 per cent of the total value of metals produced from lode mines in the State in 1929.

The yield of gold by dredges in the State in 1929 showed a decrease of $841,654 compared with the output in 1928. The nine counties in which dredges operated were Amador, Butte, Calaveras, Merced, Sacramento, Shasta, Stanislaus, Trinity, and Yuba. The total quantity of gravel dug by all dredges was 43,434,590 cubic yards (49,142,099 in 1928), indicating an average recovery in gold and silver of 8.28 cents a yard, compared with 9.03 cents in 1928 and 10.66 cents in 1927. The total production of gold by dredges since the beginning of the industry (on the Feather River) has been $163,553,943, of which the Feather River field has yielded $33,272,684, the Yuba River field $64,239,754, and the American River field $39,121,399.

The gold-mining industry was disappointed by the veto of the bill to permit hydraulic mining; this measure had been under discussion since 1928. Moreover, the question of taxation in connection with operating costs continues to be a major concern of the industry.

On the Mother Lode the tailings of the Plymouth mill were worked experimentally by lessees, who tried concentration with a series of burlap tables arranged one over the other. At Sutter Creek the Central Eureka Mining Co. operated full time, and at the Argonaut mine prospecting was continued in new territory at greater depth and at the same time its mill was kept running at capacity. The Kennedy Mining & Milling Co. did not resume full activity until May. In Tuolumne County the metal output from pocket mining increased from properties worked in the vicinity of Columbia and Sonora. In Mariposa, the southernmost county, some sensational pockets of gold were opened, and lessees continued to operate the Original mine. A report[4] giving a description of the geology and total production of metals of the Mother Lode mines was recently issued by the United States Geological Survey.

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[4] Knopf, Adolph, The Mother Lode System of California: U. S. Geol. Survey Prof. Paper 157, 1929, 88 pp.

Ore treated and gold and silver recovered at gold mills in Mother Lode counties in California in 1929 [1]

County	Ore treated	Gold and silver recovered in bullion			Concentrates produced [2]	Gold and silver recovered from concentrates			Value of total recovery	
		Gold	Silver	Average value per ton of ore		Gold	Silver	Average value per ton of concentrates	Total	Average value per ton of ore
	Short tons	*Fine ounces*	*Fine ounces*		*Short tons*	*Fine ounces*	*Fine ounces*			
Amador	200,874	59,101.59	12,119	$6.11	4.044	13,672.49	4,098	$70.43	$1,513,016	$7.53
Calaveras	4,127	1,635.09	542	8.26	273	761.08	1,207	59.99	50,465	12.23
Eldorado	6,099	1,637.58	257	5.57	108	363.60	101	70.09	41,559	6.81
Mariposa	18,246	4,105.54	956	4.68	22	72.81	122	71.36	86,949	4.77
Tuolumne	1,043	2,614.82	262	51.96	2	6.85	1	71.50	54,336	52.10
	230,389	69,094.62	14,136	6.23	4,449	14,876.83	5,529	69.79	1,746,325	7.58
Total, 1928	319,553	95,643.94	21,473	6.23	7,017	23,454.10	7,559	69.73	2,478,960	7.76

[1] Tailings excluded.

[2] Includes only concentrates recovered from gold ore.

ORE CLASSIFICATION

Ore, tailings, etc., sold or treated in California, 1921–1929, with content in terms of recovered metals

DRY GOLD ORE

Year	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1921	863,720	353,993.36	108,603	9,878	640	
1922	984,785	430,809.45	97,128	3,296	1,981	
1923	789,026	311,477.79	82,787	192	288	
1924	986,098	383,796.60	155,869	700	5,613	
1925	803,712	359,390.88	104,560	122		
1926	660,095	306,451.20	98,427	119,846	3,991	
1927	576,976	261,778.49	97,444	706	5,552	
1928	743,534	266,832.42	85,521	2,697	2,800	
1929	548,564	202,574.72	73,593	8,232	13,379	

DRY SILVER ORE

Year	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
1921	38,846	8,940.86	3,220,927			
1922	67,363	5,092.94	2,375,361	7,514	215	
1923	136,633	9,979.00	2,762,977	4,950	4,130	
1924	89,760	8,255.74	2,295,683			
1925	82,913	7,073.75	1,992,859			
1926	57,231	4,069.57	1,154,087	714	679	
1927	42,146	3,134.97	935,145	18,301	1,261	
1928	53,907	3,249.05	920,617	2,247	2,520	
1929	25,160	2,247.68	481,300	4,356	249	

COPPER ORE

Year	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
1921	306,134	1,439.01	175,870	11,599,540		
1922	447,200	5,728.85	320,977	21,845,111	214	
1923	571,645	8,523.74	360,345	28,238,052		
1924	917,806	21,129.50	876,293	51,668,117		
1925	999,006	16,584.58	704,506	[1]46,166,627		
1926	930,464	11,233.14	397,174	[1]31,413,715	687	
1927	854,084	16,556.80	393,533	[1]26,288,052		
1928	901,562	16,677.34	413,326	[1]25,115,682	3,000	
1929	1,080,355	20,041.03	547,183	[1]33,190,562	12,686	

[1] Includes copper from mine water.

Ore, tailings, etc., sold or treated in California, 1921–1929, with content in terms of recovered metals—Continued

LEAD ORE

Year	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1921	3, 947	806. 93	82, 267	34, 853	1, 123, 636	------------
1922	26, 466	1, 451. 81	263, 681	65, 944	6, 305, 832	------------
1923	38, 304	1, 654. 38	330, 241	66, 881	9, 510, 172	------------
1924	16, 536	795. 37	188, 098	78, 354	4, 758, 193	------------
1925	18, 208	2, 277. 62	174, 494	58, 342	6, 364, 985	27, 238
1926	30, 445	1, 027. 29	128, 027	34, 669	6, 740, 354	------------
1927	14, 066	330. 46	72, 644	13, 841	2, 290, 862	------------
1928	3, 401	266. 95	39, 443	20, 950	1, 783, 806	------------
1929	2, 966	360. 07	60, 641	14, 183	1, 394, 981	------------

ZINC ORE

Year	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
1921	2, 953	50. 99	2, 926	99, 133	------------	846, 184
1922	14, 072	529. 48	15, 390	613, 482	------------	3, 012, 950
1923	------------	------------	------------	------------	------------	------------
1924	9, 000	200. 00	22, 500	360, 000	------------	3, 060, 000
1925	33, 384	180. 02	33, 492	639, 822	4, 072	11, 125, 523
1926	57, 079	950. 99	150, 053	1, 875, 230	6, 695	17, 866, 237
1927	24, 266	335. 68	71, 074	798, 722	1, 780	6, 711, 250
1928–1929	------------	------------	------------	------------	------------	------------

LEAD-COPPER ORE

Year	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
1921	------------	------------	------------	------------	------------	------------
1922	47	9. 95	7, 915	4, 138	4, 294	------------
1923	83	44. 87	2, 788	7, 684	35, 090	------------
1924–1925	------------	------------	------------	------------	------------	------------
1926	383	135. 60	5, 022	22, 125	173, 207	------------
1927	193	69. 08	3, 383	13, 386	121, 867	------------
1928	137	64. 65	2, 653	9, 167	98, 911	------------
1929	24	15. 15	866	1, 661	8, 194	------------

LEAD-ZINC ORE[2]

Year	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Zinc
1925	1, 456	2. 50	25, 926	------------	197, 143	336, 476
1926	25, 162	6. 62	70, 308	------------	1, 167, 900	2, 567, 650
1927	14, 679	------------	26, 116	------------	296, 692	1, 351, 375
1928–1929	------------	------------	------------	------------	------------	------------

[2] No lead-zinc ore, classified as such, in 1921 to 1924, inclusive.

Ore, tailings, etc., sold or treated in California in 1929, with content in terms of recovered metals

Source	Mines producing	Ore, tailings, etc.	Gold	Silver	Copper	Lead
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry gold ore and tailings	251	548, 564	202, 574. 72	73, 593	8, 232	13, 379
Dry silver ore	6	25, 160	2, 247. 68	481, 300	4, 356	249
Copper ore, tailings, etc	36	1, 080, 355	20, 041. 03	547, 183	[1] 33, 190, 562	12, 686
Lead ore	30	2, 966	360. 07	60, 641	14, 183	1, 394, 981
Lead-copper ore	1	24	15. 15	866	1, 661	8, 194
Total, lode mines	324	1, 657, 069	225, 238. 65	1, 163, 583	[1] 33, 218, 994	1, 429, 489
Total, placers	478	------------	187, 240. 60	13, 312	------------	------------
	802	1, 657, 069	412, 479. 25	1, 176, 895	[1] 33, 218, 994	1, 429, 489
Total, 1928	747	1, 702, 541	521, 739. 59	1, 478, 771	[1] 25, 150, 743	1, 891, 037

[1] Includes copper from mine water.

Value of metals from ore, tailings, etc., sold or treated in California in 1929, by kinds of ore

Kind of ore	Ore, tailings, etc.	Gold	Silver	Copper	Lead	Total value
	Short tons					
Dry gold ore and tailings	548, 564	$4, 187, 591	$39, 225	$1, 449	$843	$4, 229, 108
Dry silver ore	25, 160	46, 464	256, 533	767	16	303, 780
Copper ore, tailings, etc	1, 080, 355	414, 285	291, 649	[1] 5, 841, 539	799	6, 548, 272
Lead ore	2, 966	7, 443	32, 322	2, 496	87, 884	130, 145
Lead-copper ore	24	313	461	292	516	1, 582
	1, 657, 069	4, 656, 096	620, 190	[1] 5, 846, 543	90, 058	11, 212, 887

[1] Includes value of copper from mine water.

Ore, tailings, etc., sold or treated in California in 1929, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amador	[1] 226, 445	74, 770. 81	17, 306		
Butte	150	79. 38	14		
Calaveras	6, 575	[2] 3, 718. 33	[2] 3, 590	1,012	5, 830
Eldorado	6, 104	2, 008. 27	362		
Fresno	15	15. 42	6		
Inyo	[3] 1, 756	481. 44	161	103	229
Kern	30, 694	7, 146. 16	4, 217		
Lassen	20	8. 11	4		
Los Angeles	5	7. 06	20		
Madera	65	33. 34	13		
Mariposa	18, 301	[2] 4, 263. 29	[2] 1, 185		
Mono	699	429. 46	428		
Monterey	8	12. 70	2		
Nevada	207, 256	85, 856. 74	40, 804	5, 655	6, 664
Placer	795	266. 21	49		
Plumas	1, 125	547. 69	144		
Riverside	8	11. 81	2		
San Bernardino	[4] 1, 744	646. 76	1, 028	1, 462	551
San Diego	31	13. 75	7		
Shasta	227	401. 06	77		
Sierra	41, 387	17, 200. 22	3, 283		
Siskiyou	1, 626	1, 013. 55	315		
Trinity	[5] 1, 394	376. 85	101		
Tuolumne	[6] 1, 449	2, 939. 60	454		105
Ventura	35	22. 86	6		
Yuba	650	303. 85	15		
	548, 564	202, 574. 72	73, 593	8, 232	13, 379
Total, 1928	743, 534	266, 832. 42	85, 521	2, 697	2, 800

DRY SILVER ORE

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead
Kern	3	0. 55	111		
Napa	9, 440	860. 16	144, 180	4, 356	249
San Bernardino	15, 717	1, 386. 97	337, 009		
	25, 160	2, 247. 68	481, 300	4, 356	249
Total, 1928	53, 907	3, 249. 05	920, 617	2, 247	2, 520

[1] Includes 25, 537 tons of tailings cyanided.
[2] Includes gold and silver from mill cleanings.
[3] Includes 1, 700 tons of tailings cyanided.
[4] Includes 200 tons of tailings cyanided.
[5] Includes 731 tons of tailings cyanided.
[6] Includes 80 tons of mill cleanings smelted and 300 tons of tailings cyanided.

Ore, tailings, etc., sold or treated in California in 1929, by counties, with content in terms of recovered metals—Continued

COPPER ORE

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Alameda	[7] 15,000		104	100,233	
Alpine	28			7,260	
Calaveras	23,369	36.00	2,762	1,189,770	2,440
Del Norte	27		6	5,002	
Fresno	26	14.00	44	2,100	
Humboldt	514	10.28	154	64,552	
Inyo	14		2	2,304	
Los Angeles	30	2.00	38	1,981	
Madera	129	16.00	873	19,135	
Mariposa	30	2.00	4	6,298	
Mono	232	47.63	51,088	16,309	9,897
Plumas	852,692	17,596.96	408,239	24,929,390	
Riverside	15		1,466	1,465	
San Bernardino	758	79.16	1,960	78,828	138
Shasta	[8] 169,703	979.00	57,772	[9] 6,033,624	
Siskiyou	265	17.00	948	34,349	
Trinity	16,655	836.00	17,056	615,579	
Tuolumne	868	405.00	4,667	82,383	211
	1,080,355	20,041.03	547,183	[9] 33,190,562	12,686
Total, 1928	901,562	16,677.34	413,326	[9] 25,115,682	3,000

LEAD ORE

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead
Inyo	2,717	320.42	42,515	13,479	1,331,453
Mono	24	7.89	1,275	443	9,788
Orange	3	1.38	839		1,471
San Bernardino	222	30.38	16,012	261	52,269
	2,966	360.07	60,641	14,183	1,394,981
Total, 1928	3,401	266.95	39,443	20,950	1,783,806

LEAD-COPPER ORE

County	Ore, tailings, etc.	Gold	Silver	Copper	Lead
Inyo	24	15.15	866	1,661	8,194
	24	15.15	866	1,661	8,194
Total, 1928	137	64.65	2,653	9,167	98,911

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[7] Pyrites roasted for the manufacture of sulphuric acid—residue leached.

[8] Includes 72,818 tons of pyrites roasted for the manufacture of sulphuric acid—residue leached—and 459 tons of old mill and smelter cleanings, slag, and matte resmelted.

[9] Includes copper from mine water.

METALLURGIC INDUSTRY

The Selby lead smelter and refinery at Selby is of importance to the Pacific Coast States, particularly California, as it reduces lead ores and concentrates and refines gold-silver bullion and other metals; it was the only smelter operating in California in 1929. Gold-silver bullion was also refined at the United States mint, which purchases bullion in lots of $100 or more. Smaller bullion lots were sold to various refiners or purchased by banking establishments.

Ores and concentrates were also shipped to the Tacoma copper smelter in Washington; to Hayden and Superior, Ariz.; and to Garfield, Midvale, Murray, and Tooele, Utah. The Utah smelters, some of which also do custom milling, treated ores by flotation.

Only two custom milling plants in California were in operation—the Tropico amalgamation and cyanidation plant in Kern County and the cyanide plant of the Amador Metals Reduction Co. in Amador County.

A list of the milling plants, with details of their equipment, in California in 1925 was prepared by the Bureau of Mines[5] and may be had upon request. Of the 336 mills, which may have been more or less serviceable in 1925, only 188, not including 53 hand mortars and arrastres, were active in 1929. Of the mills active in 1929, 135 plants, largely stamp mills, used the amalgamation process only; 21 used amalgamation and concentration, of which 3 sold concentrates to a custom cyanide plant, 2 reground their concentrates and treated them by cyanide, and 1 sold its concentrates to a lead smelter; 3 used amalgamation and cyanidation; 5 used gravity concentration; 13 used straight flotation, 2 of which treated pulp directly from amalgamation plates; 9 used cyanidation; and 2 leached residues from roasted copper-bearing iron pyrite and produced cement copper.

In 1929 ore, tailings, etc., from California mining operations amounted to 1,657,069 tons, of which 41,386 tons was ore shipped crude to smelters, 505,471 tons was ore sent to amalgamation and cyanidation mills with or without supplementary concentration, and 993,387 tons was ore sent to mills equipped for concentration only. Of the 505,471 tons of ore to amalgamation and cyanidation mills 278,697 tons was treated by amalgamation followed by concentration. The total ore concentrated, therefore, was 1,272,084 tons, or 77 per cent of the total ore, tailings, etc., treated. The 41,386 tons of crude ore shipped to smelters was classified as follows: Dry gold ore, 583 tons; dry silver ore, 808 tons; copper ore, 37,513 tons; lead ore, 2,458 tons; and lead-copper ore, 24 tons.

The 537,734 tons of ore, concentrates, and tailings (sands and slimes) treated at amalgamation and cyanidation mills was classified as dry gold material. Of the total material treated by amalgamation and cyanidation 503,167 tons was ore amalgamated, 2,304 tons was ore directly cyanided, 28,468 tons was tailings (sands and slimes) cyanided, and 3,795 tons was concentrates cyanided. The 1,272,084 tons of ore concentrated (including 278,697 tons first treated by amalgamation) was classified as follows: Dry gold ore, 292,659 tons; dry silver ore, 24,352 tons; copper ore, 954,565 tons; and lead ore, 508 tons. Of the total ore concentrated flotation plants treated 993,207 tons, classified as follows: Dry gold ore, 13,932 tons; dry silver ore, 24,352 tons; copper ore, 954,565 tons; and lead ore, 358 tons. Flotation plants produced 64,333 tons of concentrates, classified as follows: Dry gold concentrates, 374 tons; silver concentrates, 1,658 tons; copper concentrates, 62,220 tons; and lead concentrates, 81 tons.

The miscellaneous material, other than ore and tailings milled and ore smelted, consisted of 539 tons of mill and smelter cleanings, slag, and matte resmelted, of 87,818 tons of pyrites roasted for the manufacture of sulphuric acid, and of mine-water precipitates. The sinter resulting from the roasting of pyrites was leached and yielded 488,400 pounds of copper.

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[5] Hill, J. M., Reduction Mills in California in 1925: Inf. Circ. 6023, Bureau of Mines, March, 1927, 35 pp.

Mine production of metals in California in 1929, by methods of recovery

Method of recovery	Material treated	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Ore amalgamated	503,167	149,467.85	38,138		
Ore and tailings (sands and slimes) cyanided	30,772	19,042.37	7,077		
Concentrates [1] cyanided	3,795	11,776.68	3,486		
Ore smelted	41,386	4,433.13	332,931	3,551,626	1,370,899
Concentrates smelted:					
Flotation	64,333	24,608.64	774,217	29,001,686	41,954
Table and vanner	999	5,058.66	4,648	456	16,636
Pyrites roasted for acid—residue leached	[2] 87,818		104	488,400	
Miscellaneous material (mill and smelter cleanings, slag, and matte) smelted	539	266.28	1,059	[3] 176,826	
Bullion from placer mining		187,240.60	13,312		
Bullion from pocket mining		10,585.04	1,923		
		412,479.25	1,176,895	[3] 33,218,994	1,429,489
Total, 1928		[4] 521,739.59	[4] 1,478,771	[3] 25,150,743	1,891,037

[1] From 145,733 tons of ore and 240 tons of tailings first amalgamated or cyanided.
[2] Residue leached amounted to 59,737 tons.
[3] Includes copper from mine water.
[4] Includes gold and silver from pocket mining as follows: 10,104.58 ounces of gold and 2,111 ounces of silver.

Mine production of metals from gold and silver mills in California in 1929, by counties

County	Ore, tailings, etc., treated		Recovered in bullion			
			Amalgamation		Cyanidation	
	Ore	Tailings, etc.	Gold	Silver	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Amador	200,874	25,537	57,196.29	11,482	3,645.08	1,517
Butte	150		79.38	14		
Calaveras	4,157		1,643.13	543		
Eldorado	6,099		1,637.58	257		
Fresno	15		15.42	6		
Inyo	40	1,700	24.02	7	297.53	43
Kern	30,542		6,197.96	2,281	731.04	420
Lassen	20		8.11	4		
Madera	65		33.34	13		
Mariposa	18,246		4,115.64	960		
Mono	698		223.09	147	154.23	226
Monterey	8		12.70	2		
Nevada	195,665		66,733.66	20,313	13,571.69	4,519
Placer	795		266.21	49		
Plumas	1,118		509.05	133		
Riverside	8		11.81	2		
San Bernardino	1,331	200	142.41	61	251.05	288
San Diego	31		13.75	7		
Shasta	225		366.95	67		
Sierra	41,386		16,997.37	3,232		
Siskiyou	1,607		887.64	152		
Trinity	663	731	267.80	55	109.05	46
Tuolumne	1,043	300	2,614.82	262	10.75	9
Ventura	35		22.86	6		
Yuba	650		31.90	6	271.95	9
	505,471	28,468	[1] 160,052.89	[1] 40,061	19,042.37	7,077
Total, 1928	612,665	116,667	[1] 211,478.16	[1] 48,902	15,446.96	289,392

[1] Includes gold and silver from pocket mining as follows: 1929, 10,585.04 ounces of gold and 1,923 ounces of silver; 1928, 10,104.58 ounces of gold and 2,111 ounces of silver; quantity of ore not recorded.

Mine production of metals from gold and silver mills in California in 1929, by counties—Continued

County	Concentrates and recovered metal				
	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amador	4,044	13,672.49	4,098	----------	----------
Calaveras	273	761.08	1,207	----------	5,603
Eldorado	108	363.60	101	----------	----------
Inyo	13	56.88	36	----------	----------
Mariposa	22	72.81	122	----------	----------
Mono	1	1.37	8	----------	601
Nevada	269	1,640.38	1,753	----------	3,147
Sierra	31	182.25	46	----------	----------
Siskiyou	8	44.73	46	----------	----------
Tuolumne	2	6.85	1	----------	----------
	4,771	16,802.44	7,418	----------	9,351
Total, 1928	9,189	38,039.76	13,180	1,066	2,800

Mine production of metals from concentrating mills in California in 1929, by counties

County	Ore to concentrating mills	Concentrates and recovered metal				
		Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Calaveras	25,549	3,570	1,278.13	4,376	1,145,362	2,667
Inyo	500	105	24.25	1,179	456	40,763
Napa	9,440	204	860.16	144,180	4,356	249
Nevada	11,591	353	3,911.01	14,219	5,655	3,517
Plumas	852,679	52,109	17,595.96	408,158	24,927,232	----------
San Bernardino	14,920	1,458	972.03	200,176	----------	2,043
Shasta	78,708	6,557	----------	2,645	2,919,081	----------
	993,387	64,356	24,641.54	774,933	29,002,142	49,239
Total, 1928	792,991	46,273	17,995.70	935,725	21,141,121	7,964

Gross metal content of California concentrates in 1929, by kinds of concentrates

Kind of concentrates	Concentrates (dry weight)	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry gold	5,139	21,958.21	23,415	9,524	16,550
Dry silver	1,658	1,832.19	343,465	6,224	262
Copper	62,220	17,627.96	413,393	30,197,268	4,067
Lead	110	25.62	2,078	651	45,700
	69,127	41,443.98	782,351	30,213,667	66,579

Mine production of metals from California concentrates in 1929, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amador	4,044	13,672.49	4,098		
Calaveras	3,843	2,039.21	5,583	1,145,362	8,270
Eldorado	108	363.60	101		
Inyo	118	81.13	1,215	456	40,763
Mariposa	22	72.81	122		
Mono	1	1.37	8		601
Napa	204	860.16	144,180	4,356	249
Nevada	622	5,551.39	15,972	5,655	6,664
Plumas	52,109	17,595.96	408,158	24,927,232	
San Bernardino	1,458	972.03	200,176		2,043
Shasta	6,557		2,645	2,919,081	
Sierra	31	182.25	46		
Siskiyou	8	44.73	46		
Tuolumne	2	6.85	1		
	69,127	41,443.98	782,351	29,002,142	58,590
Total, 1928	55,642	56,035.46	948,905	21,142,187	10,764

BY KINDS OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead
Dry gold	5,139	21,958.21	23,415	6,667	12,494
Dry silver	1,658	1,832.19	343,465	4,356	249
Copper	62,220	17,627.96	413,393	28,990,663	2,440
Lead	110	25.62	2,078	456	43,407
	69,127	41,443.98	782,351	29,002,142	58,590

Gross metal content of California crude ore shipped to smelters in 1929

Kind	Quantity (dry weight)	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Gold ore	583	1,274.97	2,951	1,725	926
Silver ore	808	415.49	137,835		
Copper ore	37,513	2,393.07	132,716	3,671,535	10,926
Lead ore	2,458	334.45	58,563	19,765	1,387,313
Lead-copper ore	24	15.15	866	2,556	8,625
	41,386	4,433.13	332,931	3,695,581	1,407,790

Mine production of metals from California crude ore shipped to smelters in 1929, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Alpine	28			7,260	
Amador	34	256.95	209		
Calaveras	238	71.99	226	45,420	
Del Norte	27		6	5,002	
Eldorado	5	7.09	4		
Fresno	26	14.00	44	2,100	
Humboldt	514	10.28	154	64,552	
Inyo	2,271	414.33	42,279	17,091	1,299,113
Kern	155	217.71	1,627		
Los Angeles	35	9.06	58	1,981	
Madera	129	16.00	873	19,135	
Mariposa	85	76.84	107	6,298	
Mono	257	106.29	52,410	16,752	19,084
Orange	3	1.38	839		1,471

Mine production of metals from California crude ore shipped to smelters in 1929, in terms of recovered metals—Continued

BY COUNTIES—Continued

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Plumas	20	39.64	92	2,158	
Riverside	15		1,466	1,465	
San Bernardino	1,990	777.78	155,484	80,551	50,915
Shasta	17,720	993.11	54,167	2,549,550	
Sierra	1	20.60	5		
Siskiyou	284	98.18	1,065	34,349	
Trinity	16,655	836.00	17,056	615,579	
Tuolumne	894	465.90	4,760	82,383	316
	41,386	4,433.13	332,931	3,551,626	1,370,899
Total, 1928	175,847	3,943.38	172,699	3,644,070	1,880,273

BY KINDS OF ORE

	Ore	Gold	Silver	Copper	Lead
Dry gold	583	1,274.97	2,951	1,565	885
Dry silver	808	415.49	137,835		
Copper	37,513	2,393.07	132,716	3,534,673	10,246
Lead	2,458	334.45	58,563	13,727	1,351,574
Lead-copper	24	15.15	866	1,661	8,194
	41,386	4,433.13	332,931	3,551,626	1,370,899

REVIEW BY COUNTIES

ALAMEDA COUNTY

Copper has been produced the past four years from pyritic ores mined in Alameda County and shipped for the manufacture of acid at the works of the Stauffer Chemical Co., at Stege, where the Blowski Copper Co. has a leaching plant which it operates on the sintered material in the production of cement copper. Such production has not been included in the earlier reports of this series. Formerly part of the copper produced in Alameda County was obtained from heap leaching of the old Alma mine dump. This mine was opened in 1892 and worked almost continuously until 1921; since then it has been idle. It is opened by more than 5,000 feet of tunnels and drifts. In 1929 the Leona Heights mine, 1 mile south of the Alma, was operated by the Leona Chemical Co. of Oakland, which sold its pyrites to the Stauffer Chemical Co. The ore is said to average about 47 per cent of sulphur, 1.5 per cent of copper, and $1.50 in gold. It was trammed to a crushing plant, then transported on cars of the Key System electric line, which passes within 1,600 feet of the crusher, to the Southern Pacific railroad. The geology and a description of the mines are given by Lawson[6] and extracts from Lawson's report and a recent review of operations are given by the State mineralogist.

ALPINE COUNTY

A shipment of high-grade oxidized copper ore containing no gold or silver was made in 1929 from the Leviathan property, 7 miles southeast of Markleeville, in the Monitor district; the mine had been idle for a long period of years. The metal output of Alpine County in 1928 came from lead ore mined on the Joe Larsen property near Loope, but no production was reported from this property for 1929.

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[6] Lawson, Andrew C., U. S. Geol. Survey Geol. Atlas, San Francisco Folio 193, 1915, p. 22. California State Division of Mines Twenty-fifth Annual Report, 1929, pp. 439–441.

AMADOR COUNTY

The total value of metals produced in Amador County decreased from $2,251,441 in 1928 to $1,611,253 in 1929, a loss of $640,188 and next to the largest decrease in the State. Of the entire gold value for the county ($1,601,861) placer mining yielded $56,211 or $42,579 more than in 1928, but lode gold decreased from $2,223,290 in 1928 to $1,545,650 in 1929, a loss of $677,640. Named in order of output in 1929, the ranking gold producers of the county were the Argonaut, Central Eureka, and Kennedy mines, the Lancha Plana dredge, and the Moore mine.

At the 60-stamp mill of the Argonaut mine, treating about 250 tons of ore a day during 1929, about 65 per cent of the gold was recovered by amalgamation and in sulphides concentrated on 36 Frue vanners. A sluice from the mill carries the tailing about a quarter of a mile for treatment at the works of the Amador Metals Reduction Co., which has handled by direct cyanidation the entire tailing product for the past six years. Both sand and slime were directly treated, the slime after preoiling on the lines of the Silver-Dorfmann process and the sand by percolation, sometimes with and sometimes without preoiling. The metallurgy required in the re-treatment of "Mother Lode" carbonaceous slime tails is reviewed in a paper[7] published by the Bureau of Mines.

The mine and mill of the Kennedy did not start operations until in May, following a period of reconstruction after the fire at the property the previous September. The cessation of active mining at this property for such a long period was one of the contributing factors to the large decrease in the lode gold output of the county. At the Moore property mine and mill operations were carried on intermittently until June, when work ceased for lack of ore. A letter to stockholders of the Moore Mining Co., dated October 7, 1929, states, "As a result of this apparent exhaustion of the accessible parts of the Moore vein, our development program is restricted to the Kennedy-Argonaut and South Jackson veins." The cyanidation plant of the Amador Reclamation Development Co. treated current and stored Moore tailings for 10 months of 1929 and then closed down.

Less ore was mined at the Central Eureka, and the bullion output of gold and silver was lowered accordingly, owing in part to the inability of the company to mine or mill ore when the 4,700-level intermediate ore body started to settle at about 90 feet above this level.[8]

The cyanide plant of the Amador Metals Reduction Co. continued the treatment of concentrates and small lots of ore and tailings from properties in the vicinity of Jackson and elsewhere. Lessees of the Plymouth tailing dump attempted the recovery of sulphides with the use of burlap tables. Operations ceased after the recovery of 6 tons of concentrates averaging approximately $160 in gold and 2 ounces of silver to the ton. The Coeur Leonis & Aurora Mining Co. developed its property in the Volcano district, 23 miles from Martel, and constructed a 3-stamp mill with ball-grinding and flotation equipment. Dump material of the Amador Queen and Lincoln properties was worked, and lessees reported production from the Amador Queen No. 2

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[7] Leaver, E. S., and Woolf, J. A., Re-treatment of Mother Lode Carbonaceous Tails: Rept. of Investigations, Serial 2998, Bureau of Mines, April, 1930, 6 pp.

[8] Central Eureka Mining Co. Annual Report for year ended April 24, 1930.

property. Much pocket or speciman gold, for which no ore-tonnage figures can be calculated, was sold to local bullion buyers or to the United States mint.

The old town site of Lancha Plana was the scene of a mining revival; an 83-bucket electric dredge of the Lancha Plana Gold Dredging Co. began operations late in July and worked 155 days on ground along the Mokelumne River. Each of the dredge buckets has a capacity of 6 cubic feet, and a total of 270,469 cubic yards of material was handled. In the same vicinity by-product gold was recovered from gravel and sand used in constructing the Pardee Dam. The Elephant (Union Flat) hydraulic placer, three-quarters of a mile from Volcano, was worked until the middle of June, and about 14,000 cubic yards of material was handled. Other placer operations in the county were small, consisting mostly of miscellaneous workings at unidentified localities.

BUTTE COUNTY

The value of the gold and silver produced from lode and placer mining in Butte County in 1929 was $72,092, an increase of $22,931 compared with 1928. Placer mining contributed $70,276 in gold, which came from 34 sluice, 7 drift, and 2 dredge operations. No large output was reported from any of the lode mines in the county; very little work was done on the Triumph lode, 7 miles from Feather Falls, where a 5-stamp mill was installed. On the Logue property, 6 miles north of Oroville, $250 in gold bullion was obtained from pocket mining.

Although two dredges operated in Butte County in 1929, only one, the Shasta Butte, was an important producer of gold; with its electric dredge it handled about 500,000 cubic yards of material during five months operation. The 6-inch suction dredge of the Gold Pan Dredging Co., in demonstrating its machinery at Kanaka Bar, made a small recovery of gold. By-product gold was won from commercial sand and gravel operations of an electric drag-line excavator by the Johnston Rock Co. on Butte Creek. The Royal and Oro Fino drift placers on the west slope of Butte Creek were recorded as producers in 1929. Development work continued for 8 months at the Aladdin drift placer on the north fork of Little Butte Creek, and a small recovery of gold was reported. In addition to gold produced from Butte Creek and its tributaries, the South and Middle Forks of Feather River and Carl Gulch in the vicinity of Magalia were credited with production of gold. Work was carried on the entire year at the property of the Genii Mining Co., near Magalia; the property is developed by an adit driven from the only point in this section low enough to cut the main Mammoth channel. The adit was extended 3,400 feet to the east rim, and from a 40-foot incline parallel drifts and laterals have been extended upstream on bedrock in the trough of the channel. This work has blocked an area 250 by 700 feet in extent, the gravel ranging from 6 to 15 feet in thickness. Apparently much of this gravel is considered pay material. The Lucky John gravel mine on the south side of Little Butte Creek, 3½ miles east of Paradise, was closed until late in the year, when preparations were made for the exploitation of the property under a 10-year lease. Other companies reporting development campaigns were the Dix Butte Placer Mining Co., on the west branch of Butte Creek and northeast of Chico, and the Empress Mining Corporation, on Feather River, 5 miles northeast from

Oroville. Much of the placer gold was won from small sluicing operations along the streams and creeks north of Oroville.

CALAVERAS COUNTY

The value of the gold, silver, copper, and lead produced from mines in Calaveras County in 1929 was $317,386, an increase of $134,298 compared with the value of the same metals in 1928. This gain in value is due to the opening of the old Calaveras copper mine, which, with three other properties, brought the copper yield of the county from 132,532 pounds in 1928 to 1,190,782 pounds in 1929. The Calaveras copper mine was operated by the Engels Copper Mining Co;[9] operations began in a small way in August. At the end of 1929 a total of 25,844 tons of ore had been milled, from which was recovered 45.73 pounds of copper to the ton, or a total of 1,181,864 pounds. The average grade of ore treated indicated 2.986 per cent of copper in the heads. At the time of taking over the management of the property the Engels Copper Mining Co. planned to develop systematically known ore bodies, to explore virgin mineral areas by drifting and crosscutting, and to sink shafts deeper so that known ore shoots could be mined at great depth. An excerpt from the Engels Copper Mining Co.'s printed report follows:

> This property is located at Copperopolis, in Calaveras County, Calif., about 45 miles east of Stockton, in the Foothill district, and consists of approximately 2,200 acres. It is one of the oldest mines in the State and has been operated at intervals since 1860 but has never been systematically or adequately developed. A number of shafts had been sunk to open the mine to a depth of about 1,100 feet vertically from surface at the time the Engels Co. became interested in the property.
>
> Equipment includes a 500-ton flotation mill, smelter with blast and reverberatory furnaces and converters, three shafts completely equipped with hoists, compressors, etc. * * *. All equipment is electrically operated. An electric tram, about a mile and a half long, is operated for transportation of ore from shaft ore bins to mill and smelter.
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> * * * The main opening of the mine, the Discovery Shaft, has been deepened 265 feet to its present depth of 1,624 feet. Two new stations have been cut, designated 1,650 level and 1,800 level. Drifts and crosscuts have been driven on the 1,650 level aggregating 680 feet. Ore and waste pockets of 360 tons capacity have been cut. Ore is exposed on this level of a fair milling grade, and stoping operations have just started. The extent of this ore has as yet not been determined, but so far 494 tons of ore have been mined, averaging 3.68 per cent copper.
>
> The 1,800 level is 150 feet below the 1,650. No drifting has been done on this level, but ore was encountered in sinking the shaft, both above and below the station.
>
> *Keystone Shaft.*—This shaft is located about 2,000 feet from the Discovery Shaft and had been sunk to a depth of about 200 feet. After unwatering and installation of a temporary hoist, sinking operations were started. The depth is now increased to a total of about 600 feet. Two stations have been cut, one at 375 feet from surface, the other 150 feet below at 525 feet. On the 375 level 408 feet of drifts and crosscuts was driven, over 300 feet of which was in ore. In the course of this work 1,477 tons of ore was sent to the mill, averaging 2.36 per cent copper.
>
> * * * Although extraction has been fairly good, the grade of concentrates produced has been too low for economical results. To improve this condition a battery of 14 cells Kraut flotation machines is now being installed, which will be in operation by March 1, 1930. This installation is ample to handle 400 tons ore daily.
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> * * * Two reservoirs, constructed to impound water during the rainy season, are the source for mill requirements.

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[9] Engels Copper Mining Co. Sixteenth Annua lReport, for year ended Dec. 31, 1929.

> At present concentrates produced are sent to the Tacoma smelter of the American Smelting & Refining Co. under an agreement for smelting. If later on it is decided to operate the smelter, blister copper would be sent to Tacoma for refining.

The Penn copper mine, idle for several years, was rehabilitated, and a 50-ton flotation mill was built on the property at Campo Seco. Test runs on oxidized dump ores were conducted for 60 days by the Mateo Mining Co., but operations ceased before the close of the year. According to a recent article[10] the Penn mine has a considerable ore reserve carrying 3.2 per cent of copper, 12 per cent of zinc, 0.8 per cent of lead, and 3.6 ounces of silver and $1.60 in gold to the ton. The placer production of the county declined from $71,169 in gold in 1928 to $26,234 in 1929, largely because of the decreased yield from dredge operations. The Isabel dredge ceased operations in 1928 after a long period of activity, but the new dredge of the Milton Dredging Co. began operating in September at South Gulch, 3 miles north of Milton.

The outstanding gold lode property in the county was the Oro-Plata group near Murphy, operated under option by the Union Consolidated Mining Co., which treated the ore by flotation and shipped concentrates to Selby. Considerable gold bullion was reported by pocket miners in the vicinity of Angels Camp, San Andreas, Valley Springs, and Westpoint.

The Vallecito Western drift property was worked until June 15; the mining methods and equipment employed here and at other near-by drift properties in Calaveras County have been described by Young.[11]

> Drilling was started in May, 1923. The channel was discovered and a shaft sunk (May, 1924). Drifting on the channel started, and although first results were not encouraging the channel soon showed gold, and development was continued until more or less cuts have been driven to the outer margins. The longest crosscut is 212 feet. Maximum width of the channel is about 300 feet. The pay lead in the channel is narrow, the breasting width being from 60 to 80 feet. Total development work is 5,300 feet. All of the gravel excavated in development has been washed, and it is estimated that in the length of channel now developed about 50,000 tons of gravel can be mined and profitably handled. * * * Production to date has been about $100,000.

The Royal Development Co. gave up its option and lease on the Royal near Hodson August 31, and the property reverted to the owner. The Kirby Development Corporation reported retimbering the Bachman shaft and drifting and crosscutting at the Thorpe mine. A little gold was produced from these operations. Near Copperopolis development work was carried on the entire year at the Gold Knoll property, which has a 10-stamp mill. No production was reported from the Union gravel mine, near Mokelumne Hill, although development work throughout the year was encouraging; shortage of water hampered washing operations.

DEL NORTE COUNTY

The value of the metals produced in Del Norte County in 1929 was more than three times that of 1928, owing to a shipment of copper ore from the Union copper claims (Zaar property) near Crescent

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[10] Engineering and Mining Journal, vol. 127, 1929, p. 214.

[11] Young, George J., Drift Mining at Vallecito: Eng. and Min. Jour., vol. 128, 1929, pp. 394–397.

City by Westfall and Bowers, who reported development only. The French Hill hydraulic property, 17 miles northeast of Crescent City, under development in 1928, was not productive in 1929.

ELDORADO COUNTY

The total output of gold and silver from 17 lode mines and 26 placers in Eldorado County in 1929 was valued at $57,916, a decrease of $64,948 as compared with 1928. The Sliger gold lode property was the largest producer of gold in the county, followed by the Rising Hope, a drift placer, and two lode mines, the Van Hooker and the Slate Mountain. The Carpender drift placer, a large producer in 1928, was idle in 1929. Much gold from pocket mining in the vicinity of Georgetown, Grizzly Flats, and Kelsey was recovered by hand mortar, adding materially to the county output of lode gold. The Middle End mine, near Grizzly Flats, was worked during the first half of the year by lessees, who shipped bullion and concentrates containing gold and a little silver. Further development work was done at the Kelsey mine, near Placerville, and its 10-stamp mill was operated a short time. Ore was developed at the Sliger property, and its 25-stamp amalgamation and concentration mill was operating at capacity. The mine is opened by a 500-foot incline shaft and by about 1,200 feet of tunnel levels and drifts. A 10-stamp amalgamation and concentration mill and an electric power line were installed and operated at the Van Hooker mine near Placerville, which is opened by a 1,200-foot adit. The New Pyramid Mining Co. was constructing a mill to treat ore by amalgamation, concentration, and cyanidation. The mine is opened by a 700-foot incline shaft, by 1,200 feet of drifts, and a tunnel 400 feet long.

FRESNO COUNTY

Gravel for commercial use was washed near Friant and was the chief source of gold in Fresno County in 1929. The Post Oak copper claim on the east side of Kings River, near Sanger, was worked until September, and 26 tons of ore assaying 4.17 per cent of copper and 0.52 ounce of gold and 1.7 ounces of silver to the ton was shipped to the smelter. At Delpiedra, the Sunnyside and the Granite Hill claims and two stamp mills were in operation, and a little gold was produced. The total value of all metals produced in the county in 1929 was $14,024.

HUMBOLDT COUNTY

Copper ore was shipped from Humboldt County for the first time since 1915. It came from the Horse Mountain copper mine and was hauled to Eureka, where it was loaded on a boat for shipment to Oakland and from there for reshipment to Liverpool. According to the customs manifest the ore was reported to assay 6.61 per cent of copper. Gravel bars in a few localities were operated by hydraulic mining along the Klamath River, chiefly in the vicinity of Orleans. The placer gold output of 27 prospectors and snipers is included in the total of $13,834 of metals produced. Hydraulic mining on the upper Klamath and lower Trinity Rivers generally ceases during the summer months so fishing in these localities will not be disturbed by the muddy streams.

IMPERIAL COUNTY

The gold and silver output of Imperial County, valued at $1,046 in 1929, was reported from prospects in the Chocolate Mountains. The Valjean property, on which a small mill was constructed in 1928, was not productive in 1929.

INYO COUNTY

The output of gold, silver, copper, and lead from 24 lode mines in Inyo County in 1929 was valued at $127,598, compared with $139,029 in 1928. Inyo was the chief lead-producing county in the State with an output of 1,339,876 pounds, valued at $84,412. The silver yield was 43,544 ounces, valued at $23,209. Of the 4,511 tons of ore and tailings treated in 1929, 2,717 tons was lead ore from 17 mines, 56 tons was gold ore from 4 mines, and 24 tons was lead-copper ore from 1 mine, supposedly in the Russ district. The Estelle Mines Corporation, with a 30-year lease on all the adjoining Cerro Gordo property, was the largest producer of lead ore in the State. The mines were operated after June 1 as the Estelle unit of the American Smelting & Refining Co., using the Cerro Gordo shaft for higher levels and the Dellaphene tunnel of the Estelle for lower levels. At the Ophir property near Trona, operated by the Engineers Exploration Corporation, the new 100-ton water gravity concentrator was put in operation in November. Ore is delivered to the crushers, and is then passed to a Hardinge rod mill operated in closed circuit with a Dorr simplex classifier. The overflow goes to a Dorr bowl classifier, which makes a sand and a slime; after being thickened in a Hardinge super-thickener each product is treated separately on Wilfley tables. The ore is reported to assay 12 per cent of lead and from 8 to 10 per cent of zinc. The ratio of concentration was about 4 or 5 of ore to 1 of concentrates. The Santa Rosa mine, a lead-silver producer, was operated by Tonopah (Nev.) interests. Other lead producers of the county were the Lead Lode near Big Pine, the Silver Spoon near Darwin, and the Noonday at Tecopa; the latter was operated under lease. The Radcliff mine near Trona was the largest producer of gold in the county; a 100-ton Marcy-type ball mill, equipped with Dorr classifiers arranged for final treatment of the sands by cyanide, was built at the property to replace the 20-stamp mill. The McCrea group, 20 miles south of Beatty, Nev., and the Cleveland near Big Pine were also large gold producers.

KERN COUNTY

Mine production of gold and silver from 30 lode mines and 4 placers in Kern County in 1929 was $148,421 in gold and $2,312 in silver, a decrease of $38,032 in gold and $2,933 in silver compared with 1928. Fourteen mines in the Randsburg district produced 27,393 tons of ore, yielding 5,685.66 ounces of gold and 1,484 ounces of silver, valued together at $118,401, or $4.32 a ton; in 1928 the district produced 27,591 tons of ore and tailings, from 7 lode mines and 1 tailings operation, yielding 7,674.22 ounces of gold and 1,986 ounces of silver, valued together at $159,802 or $5.79 a ton.

Since the beginning of its operation in 1896 the Yellow Aster mine has been one of the largest and most persistent gold producers in Kern

County, being credited with an output, according to the State mineralogist,[12] of $10,000,000 in gold and silver and a dividend record of approximately $3,000,000. The report cited contains a description of the Yellow Aster mine and mill and of the work done by the company and lessees at the time of the visit in 1928. Construction of a cyanide plant to treat the Yellow Aster tailings was completed in June, 1928, and lessees began treatment of 225 tons of sands daily. At the end of 1928 15,000 tons had been treated, yielding $5,913 in gold and silver bullion with an average fineness of 0.606 in gold and 0.139 in silver. In 1929 the tailing treatment was continued, and 25,000 tons of the material yielded bullion of about the same average fineness as in 1928; this was included with bullion recovered from the ore. The Yellow Aster 50-stamp amalgamation mill was also in operation, crushing about 70 tons of ore a day to 40-mesh and recovering on plates about 85 per cent of the gold and silver value. The bullion had a fineness of 0.765 in gold and 0.196 in silver. Two Wilfley tables treat the slimes, and the concentrates saved on the tables are ground in an amalgamation barrel, with a recovery of $15 in gold to the ton.

LASSEN COUNTY

The Badger group of claims southwest of Milford, in Lassen County, was under development by the Honey Lake Valley Gold Mining & Development Co. and was equipped in 1929 with a 10-stamp Straub mill and amalgamation plates. Tests were made on the ore, and one small lot of gold bullion was produced. According to the State mineralogist[13] the property is opened by two tunnels 160 and 430 feet long. A fissure vein of quartz in granite shows some pyrites and copper stain. Doyle, the nearest railroad station, 14 miles southeast of the mine, is reached by a good road which is within 2 miles of the mine. The elevation at the mine is 6,000 feet. Experimental work and testing the mine dumps continued on the Golden Eagle property at Hayden Hill, where a cyanide plant was installed; no production was recorded.

LOS ANGELES COUNTY

The metal output of Los Angeles County in 1929 was valued at $1,374; it consisted of metals obtained from one shipment of copper ore and one of gold ore and of gold from the sluicing of placer tailings in connection with the commercial production of sand and gravel.

MADERA COUNTY

Five lode mines and five placers in Madera County produced gold, silver, and copper valued at $5,317, compared with 5 lode mines and 3 placers with an output in 1928 valued at $5,908. The Jessie Bell mine, on the Daulton and Buchanan ranches, and the Bach and Le Barry properties were more or less active; the copper content of the ores produced ranged from 6 to 13 per cent and the silver from 1 to 4 ounces to the ton. The Jessie Bell ore averaged also $6 in gold, probably from sorted or concentrated material. These properties are in the Foothill copper belt, which extends for many miles along the eastern edge of the San Joaquin Valley, passes in a southeasterly direction through Madera County a few miles west of Raymond, and extends into Fresno County. Very little activity was reported from gold quartz mining. Only the Riverside mine, equipped with a small amalgamation mill, and the Lucky Bill mine were operated part of the year. These mines, including placers which regularly produce small quantities of gold, are described in the 1928 report of the State mineralogist.[14] Of much importance to the mining industry was the entry of the Treadwell Yukon Co.(Ltd.).[15] This company carried on prospecting during the summer in the high Sierras on lode claims that had been reported to show gold, silver, lead, zinc, and copper. These claims are in a mineral region that can be reached at the present time only by roads from the Nevada border line.

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[12] California State Division of Mines Twenty-fifth Annual Report, 1929, p. 52.

[13] California State Division of Mines Twenty-fifth Annual Report, 1929, pp. 5–6.

MARIPOSA COUNTY

Gold, silver, and copper recovered from 18,331 tons of ore from 19 lode mines in Mariposa County in 1929 were valued at $89,913, compared with 9,932 tons and $120,662 in 1928. All the ore produced in 1929, with the exception of 85 tons of ore shipped directly from 3 mines to smelters, was treated in 11 milling plants equipped chiefly for amalgamation. Only one of these plants recovered sulphides by table concentration, although two other mills similarly equipped did not recover concentrates. At one plant the concentrates were reground in a Hardinge mill and run over amalgamation plates.

The placer output in 1929, valued at $2,898, was confined to accumulations of a number of prospectors who sell or trade to storekeepers principally at Mariposa and Coulterville. Copper mining in Mariposa County began about 1860 but has never become very important. A small outcrop of copper ore of shipping grade was mined by a prospector working on the Mariposa Grant in 1929 and yielded 6,298 pounds of copper. The chief gold producer of the county was again the Original mine in the Coulterville district; the mine was operated by lessees most of the year. Second in rank in the output of gold was the Feliciana mine, followed by the Colorado mine. In the Whitlock district 591 tons of ore from the Spread Eagle mine which yielded bullion valued at $2,360 was treated at the 5-stamp mill. The other producers of gold and silver were the Vanderbilt or Diltz, McKinley and Franklin, Mariposa Extension, and Cora Belle. Nearly all the mines mentioned have been described in a recent report[16] by the State mineralogist.

MERCED COUNTY

Gold has been produced for many years from sands and gravels of nearly all the streams entering Merced County and has come almost entirely from the ancient river channels. Beginning in 1907, the most important operations were those formerly carried on at Snelling on the Merced River by the Yosemite Gold Dredging & Mining Co., which discontinued dredging in 1919. The gold bullion output recorded for Merced County was small for several years after these dredging operations ceased, and not until the La Grange Gold Dredging Co. began to produce with its 60-bucket electric dredge was the output of any importance. Another dredge is operated by the same company on the Tuolumne River, 2 miles below La Grange, in Stanislaus County, with which the output figures for Merced County are combined.

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[14] California State Mining Bureau Twenty-fourth Annual Report, 1928, pp. 321–328.
[15] Treadwell Yukon Co. (Ltd.) Annual Report for Year Ended Dec. 31, 1929.
[16] California State Mining Bureau Twenty-fourth Annual Report, 1928, pp. 77–122.

MONO COUNTY

Nine lode mines in Mono County produced in 1929 gold, silver, copper, and lead valued at $42,351, compared with $182,422 in gold and silver from four lode mines in 1928. During the development of the Comanche mine, operated by the Comanche Mining & Reduction Co. in the Blind Springs Hill district, copper ore containing 220 ounces of silver, some gold, and a little lead was shipped for testing to Midvale, Utah, and plans were reported under way for a 100-ton flotation mill. At the Serita mine, near Masonic, experimental work on about 650 tons of ore resulted in a good recovery of gold and silver by cyanidation. The dumps and surface ground of the Standard-Bodie mining property were leased by the Clinton-West Co., and a plant for treating the mine dumps and surface dirt was constructed and given a trial run in November. The plant is reported[17] to treat 100 tons of material in one 8-hour shift; it handles the dump material by flotation after it has been put through a ball mill. The ratio of concentration is 225:1. All the old bonanza mines of Bodie were taken under the control of the Treadwell Yukon Co. (Ltd.), whose exploitation of 41 mining claims and a number of millsites is partially described as follows:[18]

> Actual work was started in October, 1928, on the claims of the Southern Consolidated group and consisted of unwatering old workings abandoned since 1882. At the end of the year the water had been lowered from the 600 level to the 700 level of the Red Cloud Shaft; pumping will be continued to the bottom of this shaft on the 900 level, and if the present prospecting work so justifies then more permanent pumping equipment will be installed. Concurrently with the pumping, the upper levels were explored and sampled and several small shoots of ore were found. Development work has been started to reach these shoots on lower levels of the several veins and for exploring the veins for additional ore shoots.

MONTEREY COUNTY

Gold was recovered by amalgamation in a Huntington mill from about 30 tons of ore from the Lilac, Blackberry, and Ocean View claims on Plaskett Creek in the Los Burros district, Monterey County. The region in which these mining claims are situated was described by Hill[19] in 1923.

NAPA COUNTY

One mine produced the entire output of gold, silver, copper, and lead, valued at $95,412, credited to Napa County in 1929. The Banner Development Co. early in the year took over the Palisades (Grigsby) silver mine near Calistoga and constructed a 100-ton flotation mill. Shipments of silver concentrates began in March and continued regularly throughout the year. As development work progressed on the Easley and Palisade veins ore assaying higher in gold was encountered and even with the low price of silver the company seemed to be on a substantial operating basis. The mill and the main shaft (440 feet deep) are in different gulches with a ridge between. The mill tunnel level has been driven through this ridge from the mill to the shaft and has followed the Easley vein for a distance of 920 feet. The ore mined is quartz carrying sulphides of silver and a little gold, of which 70 to 100 tons a day is concentrated in a plant equipped with a Marcy ball mill, classifiers, and a new 6-cell Kraut flotation machine. An Oliver filter is used for dewatering tailings that are stacked. The ratio of concentration is 4.5:1, making concentrates averaging 4.16 ounces of gold and 726 ounces of silver to the ton. Further development details are given by the State mineralogist[20] for 1929.

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[17] Engineering and Mining Journal, vol. 128, 1929, p. 863.

[18] Treadwell Yukon Co. (Ltd.) Annual Report for Year Ended Dec. 31, 1929.

[19] Hill, J. M., Contributions to Economic Geology; the Los Burros District, Monterey County, Calif.: U. S. Geol. Survey Bull. 735, 1923, p. 329.

NEVADA COUNTY

The mine production of gold, silver, copper, and lead in Nevada County in 1929 was valued at $1,830,889, a decrease of $183,911 compared with 1928. The gold yield from placer mining decreased from $38,695 in 1928 to $32,797 in 1929. Mines in the Grass Valley-Nevada City district—mainly the Empire, North Star, Idaho, Murchie, and Randolph—produced 202,513 tons of ore, which yielded 80,962.53 ounces of gold and 39,869 ounces of silver, valued together at $1,694,894. The gold ores of this district usually carry some lead and copper; the lead and copper recovered in 1929 were valued at $1,415. The Quaker Hill drift mine near Nevada City was the largest contributor to the placer gold output of the county.

Of great mining interest to Nevada County and to the State as well was the consolidation of the North Star and Empire mines into one company known as the Empire Star Mines Co. (Ltd.), which was made a subsidiary of the Newmont Mining Corporation. The company closed the mill at the North Star shaft and trucked the ore broken in development work to the Empire mill, thus curtailing production until the completion of an aerial tram line to the Empire property. At the Idaho-Maryland production in 1929 increased over that of 1928 and the company was encouraged by results of the development work undertaken. The Murchie mine was operated the entire year by the American Foundation Co. and the milling process was changed from amalgamation and gravity concentration to all-flotation, a radical departure from the California practice. The daily mill capacity is 150 tons of ore; in 1929, however, it worked usually only one shift in 24 hours and averaged only 50 to 60 tons per day. Its equipment consists of 20 stamps, ball mill, classifier, 6 roughing Kraut cells and 2 finishing cells, Dorr thickener for concentrates, and Oliver filter. The concentrates with about 10 per cent moisture are sacked and hauled by auto truck 1½ miles to the railroad at Nevada City. The ratio of concentration is about 3.3 tons of ore to 1 of concentrates. The metals recovered from the ore average about $5.33 in gold and 0.8 ounce of silver to the ton, with traces of copper and lead. The minerals noted in the ore are pyrite, galena, sphalerite, arsenopyrite, and stibnite. The mine is opened by an inclined shaft sunk at 85° to 1,300 feet, 9,929 feet of drifts, 4,500 feet of raises, 419 feet of winzes, and 950 feet of crosscuts. The company reports a recovery of 94.2 per cent of the gross value of gold and silver, or 92.4 per cent after deducting freight, smelter costs, and losses. The New England Consolidated Mines curtailed milling operations at its cyanide plant, and the Western Merger Co. after about 1,000 feet of extra development work gave up the Randolph property which it operated in 1928. The Rescue-Eula Mining Co. relinquished its lease on the Gaston mine near Nevada City after operating the mine and mill the early part of the year. Much rich specimen ore from pocket mining and other sources of undetermined origin yielded high returns in gold bullion; gold from such sources continued to be a factor in the output of the gold mines in Nevada County. The quantity of ore from which this bullion was derived can not be determined; the total ore mined in Nevada County in 1929 and reported by producers, however, yielded on an average $8.09 in gold and 0.193 ounce of silver to the ton.

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[20] California State Division of Mines Twenty-fifth Annual Report, 1929, pp. 237–238.

The importance of daily records in the operation of a gold mine is discussed by the former manager of the North Star mine in a recent publication.[21]

Many properties in the county were under development throughout the year, but aside from the Ancho lode mine and those before mentioned none became productive on a large scale. Among the placers the Liberty Hill hydraulic mine was not worked, but the You Bet and North Bloomfield drift mines were productive. On account of the State débris law hydraulic mining in Nevada County has been practically abandoned.

ORANGE COUNTY

The property of the Blue Light Silver Mines Co., in Silverado Canyon near Anaheim, was under development, during which a small lot of lead-silver ore was shipped. The ore is argentiferous galena, associated with sphalerite and pyrite. The 60-ton gravity concentrator on the property was not operated. This and other mines in the region are described in a report [22] of the State mineralogist.

PLACER COUNTY

The total gold and silver output of Placer County in 1929 was valued at $34,824, of which $29,295 was from drift and sluice placer workings. Compared with 1928 the output decreased $37,473. The output of bullion from 48 placers includes that of 20 prospectors who picked up or washed gold from gravel in various parts of the county and sold or traded it for supplies from merchants. The principal lode producers, each equipped with small amalgamation mills and operating only a short time, were the Rising Sun and Annie Laurie at Colfax, Centennial and Conrad near Auburn, and the Black Hawk, east of Towle. The Trixie placer, 1 mile west of Dutch Flat, was worked by sluicing and was the largest producer of gold in the county. No mining was done in 1929 at the Home Ticket-Pacific property in the Last Chance district, but cleanings from former placer operations resulted in the shipment of a little gold. Shortage of water in the county hampered the production of gold from gulch placers, but there was considerable placering along the American River and its North Fork in the vicinity of Colfax, Gold Run, and Towle; a relatively large production of bullion reported from this source was sold to buyers. The Baker Divide drift placer, in Volcano Canyon in the Forest Hill district, and the Star United and the Twenty-one, both drift placers in the Iowa Hill district, were productive.

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[21] Foote, A. B., Estimating Head Assay from Quicksilver Feed: Eng. and Min. Jour., vol. 129, 1930, p. 407.

[22] California State Mining Bureau Twenty-first Annual Report, 1925, pp. 63-64.

PLUMAS COUNTY

In 1929 Plumas County was again the leading metal-producing county in the State, with an output valued at $4,996,967, an increase of $1,428,899 compared with 1928. The copper output increased from 21,140,975 pounds in 1928 to 24,929,390 pounds in 1929, representing 75 per cent of the State total. In 1929 two mills treated 852,679 tons of copper ore; the concentrates yielded 17,595.96 ounces of gold, 408,158 ounces of silver, and 24,927,232 pounds of copper, compared with 748,839 tons of ore in 1928, yielding 14,778.20 ounces of gold, 326,511 ounces of silver, and 21,140,805 pounds of copper. About 13 tons of copper sulphide containing 8.5 per cent of copper was shipped from a property near Indian Creek. Placer mining yielded no large individual production; the Glazier drift mine on the North Fork of the Feather River, near Seneca, made the largest output. The La Porte Mines (Inc.), 10 miles west of La Porte on the South Fork of Feather River, confined its activity to development work although some gold was recovered. Prospectors along Flat Creek in the vicinity of La Porte obtained about 50 ounces of gold bullion, and prospectors panning gravel on Lights Creek and tributaries recovered some gold. The Paramount Mining Corporation acquired the Mayflower drift property near Onion Valley; this company also operated the Pride hydraulic property on the North Fork of the Yuba River in Sierra County.

Many of the operating mines in Plumas County are mentioned and described with geological notes in a recent report [23] of the State mineralogist.

The important mining operations in Plumas County in 1929 were centered at the two large mines, the Engels and the Walker, each concentrating more than 1,000 tons of copper ore daily. The Engels mine, which is opened by a 2,021-foot shaft, has 52,568 feet of drifts and 9,430 feet of adit levels. These developments comprise the regular active workings. The ore is sulphide, containing copper, silver, and gold, and is ground and put through mechanical flotation machines. Tailings are dewatered, partly by classifiers, and lime is added to aid settling. These data with cost details are given in a recent publication [24] issued by the United States Bureau of Mines.

The Sixteenth Annual Report of the Engels Copper Mining Co., for the year ended December 31, 1929, states:

> *Production and metal sales.*—The Superior mill treated 395,042 tons of ore, an average of 1,091 tons per working day. Copper content of the ore milled averaged 1.524 per cent of copper, of which was recovered 91.34 per cent, or about

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[23] California State Mining Bureau Twenty-fourth Annual Report, 1928, pp. 261–316.

[24] Nelson, W. I., Mining Methods and Costs at the Engels Mine, Plumas County, Calif.: Inf. Circ. 6260, Bureau of Mines, April, 1930.

27.85 pounds copper per ton of ore. Total copper produced was 11,000,162 pounds. Silver produced was 114,020 ounces.

METALS PRODUCED AND SOLD, 1929

11,000,162 pounds copper at 18.1287 cents per pound	$1, 994, 185. 91
114,020 ounces silver at 50.1342 cents per ounce	57, 161. 06
1,798 ounces gold at $19 per ounce	34, 162. 31
Gross value of production	2, 085, 509. 28

COST OF COPPER PRODUCTION

		Total cost	Cost per pound, cents
Operating cost		$829, 367. 44	7. 5396
Freight and smelting charges	$592, 614. 69		
Credit by gold and silver	91, 323. 37		
		501, 291. 32	4. 5571
Operating and marketing cost		1, 330, 658. 76	12. 0967
Add reserve for depreciation		81, 293. 44	. 7390
Add development and exploration amortization		567, 417. 71	5. 1583
Total cost of copper production		1, 979, 369. 91	17. 9940

A great deal of exploration work has been carried on during the year. In the course of this work 8,490 feet of diamond drilling was done, 8,180 feet of drifts and raises were driven, and 306 feet of shaft was sunk. The most encouraging outlook for future ore supply as disclosed during the year is at depth. In the course of diamond drilling an ore shoot was cut by the drill for a distance of 31 feet on the dip, 500 feet vertically below the 13 level. This indicates the vein to be from 12 to 15 feet wide. Assays averaged 4½ per cent copper. With this exception, exploration results have been disappointing as no new ore was found during the year.

* * * The ore supply on hand is inadequate for the tonnage heretofore milled, and a reduction must soon take place if development now prosecuted continues unsatisfactory. Even if the ore struck by the diamond drill should prove to be an ore body of fairly large size, it would not be ready for mining until considerable preliminary work has been done to make it available.

During the latter part of July, 1930, the Engels Copper Mining Co. closed its mines indefinitely.

According to the printed report [25] of the Walker Mining Co., operations were continuous throughout 1929; 513,526 tons of ore was broken, of which 466,856 tons was produced. Of the ore produced 457,637 tons was milled, yielding 32,375 tons of concentrates. Of the concentrates produced 32,266 tons was shipped to the smelter in Utah; these concentrates had a metal content of 15,031,978 pounds of copper, 294,561.86 ounces of silver, and 15,400.359 ounces of gold. The average grade of the ore milled was 1.8096 per cent of copper, and 0.79 ounce of silver and 0.055 ounce of gold to the ton; the average assay of tailings was 0.1539 per cent of copper. The concentrates averaged 23.5587 per cent of copper, and the average recovery of metals was 92.10 per cent. In addition to the above metal content of the concentrates, lime scale taken from the flotation cells contained 260 pounds of copper, 195.15 ounces of silver, and 367.61 ounces of gold. Scrap copper amounting to 2,145 pounds was also shipped to the smelter. The following paragraphs are taken from the annual report of the company:

After deductions on smelter contract had been made, copper paid for by the smelter from concentrates and lime scale amounted to 13,957,968 pounds. Cost of producing this copper, after crediting gold and silver content and including refining charges, was 10.799 cents per pound. * * *

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[25] Walker Mining Co. Annual Report for year ended Dec. 31, 1929.

The mining costs for 1929, based on a ton of crude ore for breaking, producing, milling, and delivery of concentrates to the railway, were $2.5578. * * *

The operating costs per ton of crude ore for breaking and producing ore and delivery of concentrates at Spring Garden during the year were as follows:

Breaking ore, including all development	$1.2450
Producing ore, including development	.5367
Mill operating	.7115
Tramway (per ton of concentrates $0.9055)	.0646
Total	2.5578

The costs for 1925, 1926, 1927, and 1928 were, respectively, $3.5631, $3.8213, $2.7523, and $2.3391.

One mile west of the Walker mine is the property of the Walker Bros.' Consolidated Copper Co., consisting of 11 patented claims and more than 40 unpatented locations, which make up a block of ground 1 and 2 miles in length. The ore is similar to the ore of the Walker mine except that it contains more bornite than chalcopyrite. The property is in the development stage.

Quartz veins containing gold have been mined in various parts of Plumas County. Mills to treat ore by amalgamation (some with concentration equipment) at six properties crushed 1,118 tons of ore, yielding bullion containing $9.41 in gold and 133 ounces of silver to the ton. Nearly all ores mined contained copper or iron sulphides, either near the surface or at depths of a few hundred feet. Two of the mills operating in 1929 were equipped for concentration of the pulp after it had passed the plates, but the sulphides were not saved.

The Standart mine south of Greenville in the Crescent Mills district was under lease to the Yakima Mohawk Mining Co., which operated a 5-stamp mill. The Cherokee mine produced ore which was treated in a neighboring mill, while its own 100-ton plant was under construction. In the vicinity of Johnsville the Jamison mill was cleaned up by a lessee. At Seneca the Shaffer gold mine while under development produced ore which kept 5 stamps of its 10-stamp water-power mill in operation for 60 days. Litigation held back the operation of the Gold Leaf and Ohio properties in the Spring Garden district. A 40-ton Lane mill and Deister slime table treat the ore of these mines when in operation. A small lot of gold from the Dutre property in the same district was reported.

RIVERSIDE COUNTY

Fifteen tons of copper ore shipped to smelters and eight tons of free milling gold ore accounted for the production of metals, valued at $1,284, in Riverside County in 1929. The New Eldorado gold mine in the Pinon district, 50 miles southwest of Whitewater, the shipping point on the Southern Pacific, was under development. The company sank its 500-foot 80° incline shaft 100 feet deeper and added 5 stamps to its 10-stamp amalgamation and gravity concentration mill; it also added a new concentrator. This mine and others in Riverside County are described in a recent report.[26] The Mecca or Black Eagle property was not operated in 1929.

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[26] California State Division of Mines Twenty-fifth Annual Report, 1929, pp. 469-488.

SACRAMENTO COUNTY

Two companies operating eight dredges and another company working old placer tailings on the American River and producing commercial sand and gravel were the principal producers of metals in Sacramento County in 1929; a little drift and pocket mining is carried on, but the resulting gold production is small and irregular. The total county output was gold and silver valued at $1,493,621. By reason of its dredging operations the county ranked third in the State in the production of gold. The Natomas Co. operated six dredges at Natoma, handling 14,786,549 cubic yards of material in 1929; in September it leased for a period of 20 years its rock-crushing plants, equipment, and rock lands to the Pacific Coast Aggregates (Inc.), a sand and gravel company. The Capital Dredging Co. operated two electric dredges in the Ney district, 6 miles from Folsom, and planned a third dredge. The mineral resources and the growing industries in the region dredged are reviewed in a report[27] of the State mineralogist.

SAN BERNARDINO COUNTY

Thirty-three lode mines and three placers in San Bernardino County produced gold, silver, copper, and lead valued at $252,253 in 1929, or $220,264 less than in 1928. The lode metal output was from 13 producers of gold ore and tailings, 3 producers of silver ore, 10 producers of copper ore, and 7 producers of lead ore. Only 1 company in the county mined more than 15,000 tons of ore, 3 mined from 400 to 600 tons each, and 3 mined from 100 to 250 tons. The output of other producers ranged from 1 to 85 tons. The Uranium (Kelly Rand) was operated under different companies during the year, finally passing in September to the Consolidated Metals Corporation, which continued development of the property and shipped ore and concentrates to a smelter. The mine is opened by a vertical shaft 1,540 feet deep. During its operation by the California Rand Silver (Inc.) the property paid dividends amounting to $4,515,406, which includes $38,400 paid in 1929. The California Rand Silver (Inc.) issued a letter to stockholders, dated June 11, 1929, stating that owing to the low value of ore in the Randsburg property and the steadily decreasing price of silver, then at 53 cents, the company could no longer work its property at a profit. Active prospecting had failed to disclose any new ore bodies on the lower or nineteenth level or on the upper levels.

The Monarch Rand Mining Co., prospecting the Gateway group in the Fremont Peak district and operating a leased mill at Randsburg, ranked second in the county as a producer of gold from ore treated in gold and silver mills; the company shipped also one car lot of gold ore to a smelter. The Vanderbilt mine in the New York Mountains, about 4 miles east of Ivanpah, was under development; 100 tons of sulphide ore, assaying 1.19 ounces of gold and 4.59 ounces of silver to the ton and a little copper, was shipped to a smelter. The mine is opened by three shafts, the deepest 560 feet. Most of the work in 1929 consisted of cleaning out the old workings and sinking the shaft. The producers of gold ore were the Sidewinder and Santa Fe mines near Victorville, the Kramer Hills group near Adelanto, and the Red Bridge claim in the Goldstone district. The Bonanza King mine in the Trojan district ranked second in the county as a producer of silver from lead ore. Copper ore from the Anchor, near Cima, the Copper Buttes claims, 6 miles southwest of Ibis, and the Nickel Plate, 3 miles west of the Colorado River, averaged 8.6 per cent of copper. Ore mined from a prospect in the Oro Grande district was the largest source of lead in the county.

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[27] California State Mining Bureau Twenty-first Annual Report, 1925, pp. 2–32.

In the Calico district the Zenda Gold Mining Co. developed the Silver King and Oriental groups, 4 miles northwest of Yermo. The company planned to sink a 1,000-foot shaft, of which 450 feet is completed.

A dry placer in the Bellville district, 12 miles from Newberry, produced about 20 ounces of gold; the usual desert dry-washing method was used. Some ground was dry washed in the vicinity of Rialto, Red Mountain, and Randsburg.

SAN DIEGO COUNTY

The metal output from lode and placer operations in San Diego County in 1929 amounted to 62.02 ounces of gold and 9 ounces of silver, valued together at $1,287. Experimental work (placering with a small steam shovel and other equipment) was done on San Vicente Creek, 5 miles from Ramona; the gold recovered had a fineness of 0.966. The Eagle claim in the Julian district, with a 130-foot incline shaft and a 2-stamp mill, and the Nobel lode claims in Pine Valley were active part of the year.

SAN LUIS OBISPO COUNTY

On the east slope of the San Jose Range in the region of La Panza some sluicing was done in 1929 on the Navajo and Mineral Creek placer claims. The bullion produced had a gold fineness of 0.939. Near Adelaide on the western slope, along the creeks emptying into the Salinas River, a little placer mining was done; bullion with a gold fineness of 0.961 to 0.967 was produced.

SHASTA COUNTY

Gold, silver, and copper produced in Shasta County in 1929 were valued at $1,182,655, an increase of $589,916 compared with 1928. This increase in value was due entirely to the enlarged copper output, which increased from 3,055,570 pounds in 1928 to 6,033,624 pounds in 1929. The yield of gold from copper ore in 1929 was 959 ounces, virtually the same as in 1928, and the yield of silver from copper ore was 56,802 ounces, which was 98 per cent of the total silver output of the county. The county was credited with $89,689 in gold, which came from 2 copper mines, 1 dredge, 29 drift and sluicing placers, and 9 gold lode mines, 6 of which were in the French Gulch district, and from miscellaneous sources.

The Greenhorn copper mine, rehabilitated in 1928, was active throughout 1929, producing and shipping copper ore to the Tacoma smelter. New ore was developed in the sulphide zone, and a large body of oxidized gold ore forming the gossan deposit was opened up. This ore body is reported amenable to cyanidation. The Greenhorn mine, according to a recent statement by Albert Hanford, has considerable copper-bearing sulphide ore, both proven and probable, all west of the main fault and between No. 1 and No. 5 levels. The ore contains chalcopyrite and iron pyrite, as well as some cuprite and malachite in the upper workings, and occurs in lenticular deposits in a shear zone of altered rhyolite. The mine is opened by tunnels, raises, and crosscuts, to which 2,000 feet of development was added in 1929. The ore is hauled 23 miles to the railroad at Redding. Extensive improvements were made at the property of the Mountain Copper Co. (Ltd.), which shipped sulphide ore from the Iron Mountain mine to the Tacoma (Wash.) and Mason Valley (Nev.) smelters. Siliceous copper ore from the No. 8 mine was treated in its flotation plant, and the copper concentrates were shipped to Tacoma. The 300-ton cyanide plant to treat ores from the gossan deposit was not completed until late in the year. Shipments of pyrites from the Hornet mine of the Mountain Copper Co. (Ltd.) to the company's plant at Martinez and to other places for the manufacture of sulphuric acid were discontinued in November, and the mine was closed. The sintered material contains a small percentage of copper which is recovered at the company's leaching plant.

The Hobo property on Washington Ridge, in the French Gulch district, and the Janice on Spring Creek, in the Shasta district, were new producers of high-grade free milling ore. Pocket mining in the Flat Creek district yielded 18 ounces of gold bullion.

Most of the placer gold came from the operation of the Gardella electric dredge built in 1926 and at present owned by the Shasta Butte Gold Dredging Co. In 1929 this company worked over the site of the old mining camp of Horsetown and crossed over Clear Creek. A crew of men were clearing the trees from placer ground ahead of the dredge part of the year. Placer gold was reported by the Hazel Gold Mining Co. operating in Kleins Gulch and by operators of surface mines in Harrison Gulch and Churntown and at Flat Creek.

SIERRA COUNTY

Sierra County mines in 1929 produced gold and silver valued at $369,179, or $309,289 less than in 1928; of this total placer bullion and pocket mining contributed $15,127. The Sixteen to One at Alleghany, the Brush Creek in the Forest district, the Oriflamme and Bonanza King property, 3 miles southeast of Alleghany, and the Buttes Saddle at Sierra City were the principal producers of lode gold in the county. The Depot Hill hydraulic mine, 5 miles northeast of Camptonville, was the largest producer of placer gold. Next in rank in the output of placer gold were the Kirkpatrick drift placer in the Forest district and the Oro hydraulic and Lafayette drift mine in the Downieville district. The acquisition of all rights by the Pacific Gas & Electric Co. to bring in power encouraged the miners in the Downieville district. Considerable placering along Kanaka Creek and Goodyears Bar accounted for many small lots of gold bullion sold to buyers, but shortage of water was generally reported. At Sierra City the Monarch lode mine was under development, and production in 1930 was anticipated; a tunnel was driven at the Sierra Buttes to reach the quartz ledges. In the Sierra City district the

No. 4 level of the Young America was cleaned out preparatory to mine development. The mines and geology of the Alleghany district are discussed in a recent report[28] which is of interest.

SISKIYOU COUNTY

The value of metals (gold, silver, and copper) produced in Siskiyou County in 1929 was $70,751, compared with $86,138 in gold and silver in 1928. The output in 1929 is credited to 72 placer operations, 1 copper mine, and 11 gold lode mines. Named in order of output in 1929, the ranking placer mines were the Quartz Hill hydraulic on Scott River, at Scott Bar, the Summerville hydraulic on the South Fork of the Salmon River, near Cecilville, the Tony Lund on Klamath River, 14 miles west of Hornbrook, and the Hickox on the Klamath River, 3 miles above Somesbar. At the Tony Lund placer 7,000 cubic yards of gravel was handled with a gas shovel of 1¼ yards capacity. Many small lots of gold bullion were sold to the banks and stores at Yreka, Scott Bar, and Hornbrook.

Klamath River and its tributaries have been the most important agents in the distribution of placer gold through Siskiyou County. The river region and the bars of placer gravel from Hornbrook down to the mouth of the Klamath River are briefly described in a report of the State mineralogist.[29] In 1929 the Klamath River placers are credited with a production of nearly $2,000 in gold and silver. The largest production came from hydraulicking at the Hickox placer. Preliminary negotiations carried on for several months resulted in the reopening of the Blue Ledge copper mine, 4 miles from Copper; the mine began to produce in November. The property is on Joe Creek near the Oregon-California line, and the ore is hauled over the Jackson County highway for shipment to a smelter. The McKeen gold mine, 4½ miles south of Callahan on Boulder Creek, was operated 10 months of the year, and about 400 tons of ore was run through the amalgamation and concentration mill. The heads are reported to have averaged $7.50 in gold, and the recovery by amalgamation and flotation was about $1,400, almost entirely in gold. It was further reported that development work in 1929 opened up about 10,000 tons of additional ore with an average value of $9.15 a ton in gold. An oil-flotation mill was planned for the property. An amalgamation and concentration mill with oil-flotation equipment was installed at the White Bear gold quartz mine, in the Liberty district, 10 miles southeast of Sawyers Bar, but the mine was not operated. The Big Black Bear property, also in the Liberty district, was reopened by a British Columbia company. Installation of a 2-foot dredge on the Grouse Creek property was nearly completed and was expected to be ready for operation in the spring of 1930. Legal difficulties over the Independence and Buzzard Hill lode mines on the Klamath, rich gold properties, were settled; the ownership was transferred to Philadelphia people.

STANISLAUS COUNTY

The output of gold and silver in Stanislaus County in 1929 came almost wholly from an electric dredge, near La Grange, operated along the Tuolumne River by the La Grange Gold Dredging Co. The bedrock is being worked at a fair profit. The Atlas Rock Co. also recovered gold, using a drag-line steam shovel on commercial sand and gravel from which gold is caught in sluicing the sand over riffles. During 1929 about 186,000 tons of sand and gravel was handled from the bench and stream gravel deposits 3 miles east of Oakdale on the Stanislaus River.

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[28] Ferguson, H. G., and Gannett, R. W., Gold Quartz Veins of the Alleghany District, Calif.: Am. Inst. Min. and Met. Eng., Tech. Pub. No. 211, 1929, 40 pp.

[29] Haley, C. S., Gold Placers of California: California State Mining Bur. Bull. 92, 1923, pp. 86-87.

TRINITY COUNTY

The yield of gold, silver, and copper from mines in Trinity County in 1929 was valued at $470,640, a decrease of $39,372 compared with 1928, in spite of the operation of a third dredge in the county. Gold is the chief metal produced and comes mostly from the dredges operating along the Trinity River in the vicinity of Lewiston and Junction City. The Trinity and Lewiston dredges were operated the entire year and the new Madrona dredge from June 1 to the end of the year. Hydraulic mining in Trinity County is unrestricted as the streams drain directly into the Pacific Ocean and therefore cause neither menace to navigable streams nor débris injury to farm lands. Vacationists, however, have complained of the pollution of the streams and rivers. Small hydraulic and sluice operations were reported on Indian, Hay Fork, and Rush Creeks, and on the South Fork of the Trinity River, and many prospectors along the Trinity River contributed considerable bullion.

The Island Mountain copper mine is one of the largest contributors to the lode gold output of the county and has been for a long time a consistent producer of copper ore. Its output of copper in 1929 was slightly less than that in 1928. The Copper Jack mine, 15 miles from Gibson, was developed and two cars of copper ore were shipped to a smelter. A cyanide plant used for treating old tailings from the Wagner property near Carrville was moved to Strode, 4 miles distant; tailings from the old mill dump were treated until the plant was closed on account of cold weather. The Brown Bear mine in Deadwood Gulch was operated in 1929 by the Cardinal Development Corporation. Its 10-stamp mill with two Wilfley tables handled about 20 tons of ore each shift, producing gold bullion and iron concentrates.

Although much development work was done and new equipment was installed in 1928 and 1929, the Pat Holland claims, the Nash mine, and the Dutton Creek property were not productive. The Redding Creek Placers (Ltd.) developed hydraulic ground on Redding Creek, 6 miles east of Douglas City, and the Trinity Loop Mining Co. equipped its property on the south side of Trinity River, 4 miles above the mouth of South Fork, for hydraulicking early in 1930. Development work was carried on at the Golden Jubilee mine on Coffee Creek, but no production was reported.

TUOLUMNE COUNTY

Tuolumne County mines in 1929 produced gold, silver, copper, and lead valued at $88,211, an increase of $51,219 over the value of gold and silver in 1928. The production of copper accounted partly for this increase, but the gain in lode gold production from $34,376 in 1928 to $69,139 in 1929 was the chief factor. The output in 1929 came from 45 mines, only 4 of which were placers, compared with 33 mines in 1928. Pocket mining, in the course of which large masses of free gold have been found, continued to be highly productive in

Tuolumne County. Five properties in the Big Oak Flat district in 1929 produced gold bullion carrying 131.60 ounces of gold and 26 ounces of silver from this method of mining. Pocket mining in the Tuttletown district yielded 141.46 ounces of gold and 27 ounces of silver. Smaller lots of gold bullion were reported from Columbia, Confidence, Jamestown, and Sonora, where pocket mining also is productive. The principal producer of placer gold was the Stanislaus drift mine, 12 miles southwest of Jamestown on the Stanislaus River.

Cleanings from the mill of the Eagle Shawmut property on Woods Creek, 2 miles east of Chinese Camp, were sent to a smelter; tailings from the Rawhide mine, 2 miles north of Jamestown, were remilled. The chief producer of gold from lode mining in the county was the Sugarman and Nigger quartz claims of the Sugarman Mines (Inc.), on the west slope of Bald Mountain, 2 miles north of Sonora. A new Huntington amalgamation mill, which operated occasionally on small lots of ore from the mine, was built. The Sugarman has a 12-inch vein said to be extremely rich at points of intersection of the vein and the Calaveras slates. About 400 tons of tailings assaying from $11 to $30 a ton has been impounded for further treatment. Another important producer in the county was the Oak Hill mine, operated by the Oak Hill Gold Mining Co., which shipped to the Tacoma smelter sulphide ore containing gold, silver, copper, and a little lead. Some sphalerite and barite occur in the ore. The Oak Hill mine, 4 miles southeast of Cooperstown, the shipping point on the Sierra Railway, is opened by a vertical shaft 500 feet deep and its lower levels by 700 feet of drifts; the upper workings have caved. The State mineralogist says in his 1928 report [30] that the Oak Hill property was first worked as a gold mine, as were many others of similar character in the Foothill copper belt, and that the oxidized portion of the vein paid well to a depth of about 100 feet, where sulphide ore containing pyrite and chalcocite was found and at greater depth chalcopyrite. After this early work it lay idle until 1901; since that time it has been an intermittent producer. The ore reported in 1929 assayed about $9.60 in gold and 5 ounces of silver to the ton and 4.8 per cent of copper. Near Tuttletown the Pine Tree quartz claim was a producer of gold from pocket mining. The ore was first panned for coarse gold and the quartz then ground in hand mortars. The Mildred Lloyd-Star Gold Mines Consolidated, during development of its six claims along Rose Creek, produced some high-grade gold ore which was shipped to a smelter, and the Continental Mines Co. reopened its Columbia mine near Sonora and produced some gold bullion. Lazar's claim on Bald Mountain, 1½ miles from Sonora, yielded gold, as did the Musante Estate and the Ureka in the same district.

VENTURA COUNTY

The gold deposits of Ventura County are confined to the high mountainous region in the northwestern portion of the county, embracing Mount Frazer on the north and McDonald Peak on the south and known as the Piru district.[31] The Castac mine, consisting of three patented claims opened by about 3,000 feet of tunnels and drifts, was the only producer of gold in 1929; the ore persumably was treated in the 5-stamp mill driven by water power from Piru River below the mine.

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[30] California State Mining Bureau Twenty-fourth Annual Report, 1928, p. 7.
[31] California State Mining Bureau Twenty-first Annual Report, 1925, p. 230.

YUBA COUNTY

The value of the metals produced in Yuba County from 3 lode mines, 7 dredges operated by 2 companies, and 19 smaller placer operations was $1,458,687, or $850,600 less than the value of the output in 1928 and the greatest decrease recorded in any county in 1929. Yuba County fell to fifth place in total metal value and to fourth in total gold yield. The dredges are the chief source of gold in Yuba County, and the reduction in their output caused the large decrease. Yuba River gravel bars and Horse Valley, Grizzly, Oregon, and Willow Creeks in the Camptonville district yielded gold bullion by hydraulicking and sluicing. The Hammon Engineering Co., dredging along the Yuba River in the vicinity of Hammonton, operated 4 boats the entire year and 2 for only 2 months. The Garden Valley dredge was operated a few months in 1929 on its Willow Creek claims. The Red Cross lode mine near Dobbins was operated continuously with one shift and the ore was treated in the 15-ton cyanide mill on the property. This property was the largest producer of gold from quartz mining in the county.

GOLD, SILVER, COPPER, AND LEAD IN OREGON[1]

(MINE REPORT)

By V. C. Heikes[2]

SUMMARY

The total value of the mine production of gold, silver, copper, and lead in Oregon in 1929 was $486,000, an increase of $189,554, or 64 per cent, compared with 1928. This is the largest recorded value since 1924. There were increases in the output of all metals except silver, and the gold output in 1929 was the largest since 1925. Forty-five lode mines yielded gold, silver, copper, and lead valued at $238,083, and 111 placers yielded gold and silver valued at $247,917, of which $246,969 was in gold.

Of the 10,509 tons of ore and tailings treated 6,573 tons was gold ore, 3,836 tons copper ore, and 100 tons tailings. The lead recovered in 1929 came from the gold ore mined in Grant County.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1920 to 1922 is New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1920	$1.09	$0.184	$0.080	$0.081	1925	$0.694	$0.142	$0.087	$0.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064
1923	.82	.147	.070	.068	1928	.585	.144	.058	.061
1924	.67	.131	.080	.065	1929	.533	.176	.063	.066

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[1] Work on manuscript completed November, 1930.

[2] Helen M. Gaylord, of the Bureau of Mines, prepared the statistics for this report.

Mine production of gold, silver, copper, and lead in Oregon, 1920–1929, in terms of recovered metals

Year	Mines producing		Ore and tailings (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1920	20	47	82,156	49,221.08	$1,017,490	82,743	$90,190
1921	23	84	40,333	42,668.39	882,034	42,120	42,120
1922	44	126	27,522	25,714.60	531,568	151,812	151,812
1923	55	151	50,385	24,091.14	498,008	96,322	78,984
1924	43	71	44,842	26,695.36	551,842	38,103	25,529
1925	53	94	27,483	18,982.80	392,409	32,793	22,758
1926	49	100	21,727	13,243.10	273,759	29,733	18,553
1927	36	150	26,839	14,676.16	303,383	45,830	25,986
1928	41	90	12,676	10,931.19	225,968	30,924	18,091
1929	45	111	10,509	17,092.00	353,323	30,009	15,995

Year	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
1920	2,355,276	$433,371			$1,541,051
1921	174,300	22,485			946,639
1922	1,046,525	141,281	76,970	$4,233	828,894
1923	1,283,476	188,671	27,523	1,927	767,590
1924	768,395	100,660	513	41	678,072
1925	106,325	15,098	5,612	488	430,753
1926	296,454	41,504	11,549	924	334,740
1927	488,200	63,954	5,300	334	393,657
1928	358,463	51,619	13,246	768	296,446
1929	655,746	115,411	20,180	1,271	486,000

GOLD

The mine production of gold in Oregon in 1929 was $353,323, or $127,355 more than in 1928. Lode mines yielded 30 per cent and placers 70 per cent of the total gold produced, compared with 47 and 53 per cent, respectively, in 1928 and 39 and 61 per cent, respectively, in 1927. The output of gold from placers increased 105 per cent and that from lode mines 1 per cent compared with 1928. The leading gold-producing counties in Oregon in 1929 were Jackson, Grant, Josephine, Curry, and Baker, named in order of output. Douglas and Malheur Counties each made an output of less than $5,000 in gold. Coos, Lane, and Wallowa Counties made only a nominal output of gold.

Dry gold ore, of which 2,514 tons was treated in amalgamation mills, 4,035 tons in concentrating mills, and 24 tons smelted, averaged in recovered metal $15.40 in gold and 3.24 ounces of silver to the ton, and a little lead and copper.

SILVER

The mine production of silver in Oregon in 1929 was 30,009 ounces, valued at $15,995, a decrease of 915 ounces in quantity and $2,096 in value compared with 1928. The output of silver was entirely from placer bullion and gold and copper ores; no silver ore was treated for silver alone. Lode mines produced 1,914 ounces less silver and placers 999 ounces more than in 1928. Most of the lode silver in 1929 came from gold concentrates shipped from ore mined in Grant County. Copper ore sent direct to a smelter yielded 6,890 ounces. The yield of silver from placer mining amounted to 1,778 ounces.

COPPER

The mine production of copper in Oregon in 1929 was 655,746 pounds, valued at $115,411, an increase of 297,283 pounds, or 83 per cent, in quantity and $63,792, or 124 per cent, in value compared with 1928. This was the largest gain in quantity and value of any metal produced in the State in 1929. All of the copper ore mined was of smelting grade, and most of it came from Douglas and Josephine Counties. The copper ore shipped amounted to 3,836 tons and averaged in recovered metal $1.27 in gold and 1.80 ounces of silver to the ton and 8.51 per cent of copper.

LEAD

The lead produced in Oregon in 1929 was that associated with auriferous sulphides which were concentrated by flotation. The total output of lead was 20,180 pounds, an increase of 52 per cent compared with 1928.

Mine production of gold, silver, copper, and lead in Oregon in 1929, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Baker	11	15	1,238.47	$25,601	467	$249
Coos		5	10.56	218	4	2
Curry	1	5	1,853.08	38,307	319	170
Douglas	2	4	165.03	3,411	5,976	3,185
Grant	5	14	3,543.55	73,252	20,818	11,096
Jackson	6	25	7,672.15	158,597	1,229	655
Josephine	17	34	2,483.12	51,331	1,157	617
Lane	2		14.64	303	9	5
Malheur		9	109.42	2,262	21	11
Wallowa	1		1.98	41	9	5
	45	111	17,092.00	353,323	30,009	15,995
Total, 1928	41	90	10,931.19	225,968	30,924	18,091

County	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
Baker	126	$22			$25,872
Coos					220
Curry					38,477
Douglas	188,197	33,123			39,719
Grant	2,040	359	20,180	$1,271	85,978
Jackson					159,252
Josephine	464,393	81,733			133,681
Lane					308
Malheur					2,273
Wallowa	990	174			220
	655,746	115,411	20,180	1,271	486,000
Total, 1928	358,463	51,619	13,246	768	296,446

The following table summarizes the metal output of Oregon by districts. The Eastern district covers Baker, Grant, Malheur, and Wallowa Counties, and the Western district covers Coos, Curry, Douglas, Jackson, Josephine, and Lane Counties.

Mine production of gold, silver, copper, and lead in Oregon in 1929, by districts, in terms of recovered metals

District	Ore and tailings (short tons)	Gold		Silver	
		Fine ounces	Value	Fine ounces	Value
Eastern:					
Lode	3,988	1,874.14	$38,742	20,899	$11,139
Placer		3,019.28	62,414	416	222
	3,988	4,893.42	101,156	21,315	11,361
Western:					
Lode	6,521	3,270.73	67,612	7,332	3,908
Placer		8,927.85	184,555	1,362	726
	6,521	12,198.58	252,167	8,694	4,634
	10,509	17,092.00	353,323	30,009	15,995
Total, 1928	12,676	10,931.19	225,968	30,924	18,091

District	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
Eastern:					
Lode	3,156	$555	20,180	$1,271	$51,707
Placer					62,636
	3,156	555	20,180	1,271	114,343
Western:					
Lode	652,590	114,856			186,376
Placer					185,281
	652,590	114,856			371,657
	655,746	115,411	20,180	1,271	486,000
Total, 1928	358,463	51,619	13,246	768	296,446

MINING INDUSTRY

The mining industry of Oregon in 1929 experienced a slight revival in metal output, but the shortage of water hampered placer miners, particularly those engaged in surface and hydraulic work. The dredge output of gold largely accounted for the increase in total value of metals produced. Seventy-six per cent of the total value came from the Western district, comprising in 1929 Coos, Curry, Douglas, Jackson, Josephine and Lane Counties, and the balance from the Eastern district, comprising Baker, Grant, Malheur, and Wallowa Counties. Although this section yielded but about one-fourth of the State output, several lode mines were under development and one gold lode mine was the outstanding producer of all metals. The principal placer output came from the dredges in Baker and Grant Counties and from numerous small hydraulic and surface placers.

Activities in the Western mineral district resulted in a larger production of metals compared with 1928, although only a few companies participated in any large-scale operations. Dredging along Foots Creek, 2 gold lode mines in Curry and Josephine Counties, and a copper mine in Josephine County were chiefly responsible for the high value of the metal output in the Western district. A substantial output from small placer workings along the creeks and rivers draining into the Rogue River helped also to increase the total. The gold yield rom hydraulic mining fell off considerably in 1927 and 1928, and the output in 1929 from the entire district was only slightly more than 1,000 ounces of gold.

Mining in Oregon was stimulated decidedly when the Thirty-fifth Legislative Assembly of Oregon appropriated funds to be matched by funds from the United States Geological Survey, the total to be divided equally between the Eastern and Western mineral districts. Beginning in July, preliminary examinations of most of the mining districts were made, and under dates of August 4 and 7, 1930, the United States Geological Survey issued press releases on the work done.

In the statement on the Eastern district[3] the press notice states:

> Copper deposits have been known in eastern Oregon for over 50 years, yet except at the Iron Dike and adjacent mines at Homestead, on the Snake River, practically no production has been won from them. Even the Homestead properties produced for only six or seven years, and they have been shut down since 1922. Yet copper minerals, associated with gold, are exceedingly widespread in a belt over 75 miles long, extending from a locality west of North Powder eastward to and beyond the Snake River Canyon, into the Seven Devils Mountains of Idaho. * * *
>
> The existence of widespread but low-grade deposits of copper containing small amounts of gold and silver in the Keating district (Baker County) is well established. Small streaks of relatively high-grade chalcopyrite have been found, but the only hope of establishing a paying mine in this district lies in the blocking out of large ore bodies that can be mined at very low cost.

The press release for the Western district,[4] referring to the production, states:

> Although discoveries of rich ore in the upper parts of the lodes will probably continue to be made from time to time, it is evident that most of the districts have reached the stage at which the bulk of future gold production must come from the deeper zones or from low-grade ore bodies or both. * * * It follows, therefore, that in western Oregon the day of crude methods is past and that profitable exploitation will depend more and more on skillful engineering, including the application of geology. * * *
>
> The southern and principal gold-bearing region, generally referred to as southwestern Oregon, comprises Josephine County, the west half of Jackson County, most of Curry County, and adjoining parts of Douglas and Coos Counties, a total area of more than 6,000 square miles. This region lies mostly in the drainage basin of the lower Rogue River but includes areas drained by the South Umpqua, the Chetco, the south fork of the Coquille, and the Sixes Rivers. Although gold deposits are found throughout this region they are most numerous in the parts included within Jackson and Josephine Counties, which to date have yielded four-fifths or more of the total gold produced in western Oregon. * * *
>
> The bulk of the placer production has come from alluvial deposits along the streams and on terraces above them. * * * The richer and more easily accessible of the stream, terrace, and beach deposits have been worked out. There remain rather extensive bodies of comparatively low grade, some of which are suitable for dredging and others for large-scale hydraulic operations. A continuing moderate production from these sources may be expected for many years. * * *
>
> Although compared to the leading copper deposits of the country those of Oregon are small, copper lodes are among the more promising of the mineral deposits on which the future metal-mining activity of western Oregon depends. In some districts copper is associated with other metals, and small amounts have been produced from such mixed deposits, particularly in the Bohemia district. The lodes that are valuable chiefly for copper, however, are mostly confined to the southwestern part of the region, more particularly to a belt that extends from Riddle southward to the California line and includes the Galice, Kerby, and Takilma districts.

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[3] U. S. Geol. Survey press release, Copper Deposits Near Keating, Oreg.: Aug. 4, 1930.

[4] Pardee, J. T., Deposits of Gold, Copper, Quicksilver, and Associated Metals in Western Oregon: U. S. Geol. Survey press release, Aug. 7, 1930.

ORE CLASSIFICATION

Ore and tailings sold or treated in Oregon, 1921–1929, with content in terms of recovered metals

DRY GOLD ORE

Year	Ore and tailings	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
1921	37,935	19,075.66	36,490	-----------	-----------
1922	6,449	6,189.97	15,250	10,749	1,276
1923	29,472	7,506.11	25,515	3,301	857
1924	29,855	8,941.37	18,352	1,143	513
1925	24,561	9,554.34	20,369	205	4,016
1926	16,094	6,742.07	22,146	3,043	11,549
1927	10,625	4,977.88	36,376	1,720	5,300
1928	7,084	4,822.74	20,134	1,103	9,552
1929	6,673	4,909.98	21,341	2,521	20,180

DRY SILVER ORE

Year	Ore and tailings	Gold	Silver	Copper	Lead
1921	-----------	-----------	-----------	-----------	-----------
1922	3,956	8.76	119,146	23,587	75,694
1923	1,973	14.30	46,234	18,221	26,666
1924	156	2.20	4,778	2,543	-----------
1925	182	16.02	9,352	520	1,596
1926	1	.29	262	-----------	-----------
1927	-----------	-----------	-----------	-----------	-----------
1928	1,000	11.01	1,908	-----------	-----------
1929	-----------	-----------	-----------	-----------	-----------

COPPER ORE

Year	Ore and tailings	Gold	Silver	Copper	Lead
1921	2,398	434.02	1,339	174,300	-----------
1922	17,117	2,771.51	14,405	1,012,189	-----------
1923	18,940	3,181.98	22,511	1,261,954	-----------
1924	14,831	2,001.75	12,694	764,709	-----------
1925	2,740	375.06	1,941	105,600	-----------
1926	5,632	562.32	6,482	293,411	-----------
1927	16,214	811.92	8,299	486,480	-----------
1928	4,577	248.95	4,104	357,041	-----------
1929	3,836	234.89	6,890	653,225	-----------

Ore and tailings sold or treated in Oregon in 1929, with content in terms of recovered metals

Source	Mines producing	Ore and tailings	Gold	Silver	Copper	Lead
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry gold ore and tailings	41	6,673	4,909.98	21,341	2,521	20,180
Copper ore	4	3,836	234.89	6,890	653,225	----------
Total, lode mines	45	10,509	5,144.87	28,231	655,746	20,180
Total, placers	111	------------	11,947.13	1,778	----------	----------
	156	10,509	17,092.00	30,009	655,746	20,180
Total, 1928	131	12,676	10,931.19	30,924	358,463	13,246

Value of metals from ore and tailings sold or treated in Oregon in 1929, by kinds of ore

Kind of ore	Ore and tailings	Gold	Silver	Copper	Lead	Total value
	Short tons					
Dry gold ore and tailings	6,673	$101,498	$11,375	$444	$1,271	$114,588
Copper ore	3,836	4,856	3,672	114,967	----------	123,495
	10,509	106,354	15,047	115,411	1,271	238,083

The following table summarizes the ore output of Oregon by districts. The Eastern district covers Baker, Grant, and Wallowa Counties, and the Western district covers Curry, Douglas, Jackson, Josephine, and Lane Counties.

Ore and tailings sold or treated in Oregon in 1929, by districts, with content in terms of recovered metals

DRY GOLD ORE

District	Ore and tailings	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Eastern	3,975	1,859.25	20,819	2,040	20,180
Western	2,698	3,050.73	522	481	----------
	6,673	4,909.98	21,341	2,521	20,180
Total, 1928	7,084	4,822.74	20,134	1,103	9,552
COPPER ORE					
Eastern	13	14.89	80	1,116	----------
Western	3,823	220.00	6,810	652,109	----------
	3,836	234.89	6,890	653,225	----------
Total, 1928	4,577	248.95	4,104	357,041	----------

METALLURGIC INDUSTRY

Ore mined in Oregon in 1929 amounted to 10,409 short tons, of which 2,514 tons was treated at gold and silver mills, 4,035 tons at concentrating mills, and 3,860 tons sent direct to smelters. The only material treated by cyanidation in 1929 was 100 tons of tailings. Bullion recovered at 22 plants equipped for treating ore by amalgamation, not including four hand mortars or arrastres, produced $51,222 in gold and 936 ounces of silver.

The ore treated at gold and silver mills by amalgamation averaged in recovered metal $21.54 in gold and 0.39 ounce of silver to the ton.

The two concentrating mills in operation, both using flotation, produced 291 tons of concentrates, averaging in recovered metal $113.45 in gold and 69.01 ounces of silver to the ton. One lot of the total concentrates produced assayed 4.51 per cent of lead. The small output of copper ore shipped direct to smelters averaged in recovered metal $1.27 in gold and 1.80 ounces of silver to the ton, and 8.51 per cent of copper.

Mine production of metals in Oregon in 1929, by methods of recovery

Method of recovery	Material treated	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Ore amalgamated	2,514	2,619.68	970	----------	----------
Tailings cyanided	100	13.74	36	----------	----------
Ore smelted	3,860	907.75	7,138	653,225	----------
Concentrates smelted:					
Flotation	291	1,597.00	20,081	2,521	20,180
Table	1	6.70	6	----------	----------
	----------	5,144.87	28,231	655,746	20,180
Total, 1928	----------	5,100.79	30,145	358,463	13,246

The following tables summarize the metal output of Oregon by districts. The Eastern district covers Baker, Grant, and Wallowa Counties, and the Western district covers Curry, Douglas, Jackson, Josephine, and Lane Counties.

Mine production of metals from gold and silver mills in Oregon in 1929, by districts

District	Ore and tailings treated		Recovered in bullion			
			Amalgamation		Cyanidation	
	Ore	Tailings	Gold	Silver	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Eastern	836	100	390.26	660	13.74	36
Western	1,678	----------	2,229.42	310	----------	----------
	2,514	100	2,619.68	970	13.74	36
Total, 1928	3,369	----------	2,767.06	728	----------	----------

District	Concentrates and recovered metal				
	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Western district	1	6.70	6	----------	----------
	1	6.70	6	----------	----------
Total, 1928	115	861.18	9,604	1,103	8,752

Mine production of metals from concentrating mills in Oregon in 1929, by districts

District	Ore to concentrating mills	Concentrates and recovered metal				
		Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Eastern and Western	4,035	291	1,597.00	20,081	2,521	20,180
	4,035	291	1,597.00	20,081	2,521	20,180
Total, 1928	7,500	434	914.96	12,390	70,300	----------

Mine production of metals from Oregon concentrates in 1929, in terms of recovered metals

BY DISTRICTS

	Concentrates	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Eastern and Western	292	1,603.70	20,087	2,521	20,180
	292	1,603.70	20,087	2,521	20,180
Total, 1928	549	1,776.14	21,994	71,403	8,752

BY KINDS OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead
Dry gold	292	1,603.70	20,087	2,521	20,180
	292	1,603.70	20,087	2,521	20,180

Mine production of metals from Oregon crude ore shipped to smelters in 1929, in terms of recovered metals

BY DISTRICTS

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Eastern	17	21.14	165	1,116	------------
Western	3,843	886.61	6,973	652,109	------------
	3,860	907.75	7,138	653,225	------------
Total, 1928	1,807	557.59	7,423	287,060	4,494

BY KINDS OF ORE

	Ore	Gold	Silver	Copper	Lead
Dry gold	24	672.86	248	------------	------------
Copper	3,836	234.89	6,890	653,225	------------
	3,860	907.75	7,138	653,225	------------

REVIEW BY COUNTIES

BAKER COUNTY

The mine production of gold, silver, and copper from 11 lode properties and 15 placers in Baker County was valued at $25,872, or $3,293 more than in 1928. Although much development work was reported on the copper belt, only 126 pounds of copper, valued at $22, was recorded in 1929. The output of gold was valued at $25,601, of which $21,796 came from placer mining, chiefly the output of the Superior dredge near Bridgeport. This dredge operated from May to October 15 and handled 98,800 cubic yards of material. The boat was electrically driven, was equipped with 7½-cubic foot buckets, and worked 3,500 cubic yards of gravel a day.

In the Cracker Creek district about 100 tons of old Columbia mill tailings yielded by cyanidation about $2.60 in gold and 3.5 ounces of silver to the ton. The Basin mine, also in this district, yielded the largest output of lode gold in the county. The combined output of three small mines in the Greenhorn district—the Banner, Banzette, and Red Bird—was more than 50 ounces of gold from 90 tons of ore. A 20-ton pilot mill on the Banner property and a 50-ton selective flotation plant on the Snow Creek claim in Grant County were built and tested during December by the Oregon Gold Mines (Ltd.), which owns and operates the property. These mines were former producers, and during the past two years new ore has been developed in the Snow Creek tunnel and in the Banner shaft. At the United property, near Unity, a 150-ton amalgamation mill was built; the pulp is treated by flotation and the tailings are reconcentrated on tables. Bullion with a fineness of 0.756 in gold and 0.211 in silver was produced, and the concentrates were stored for future treatment. The mine is opened by four tunnel levels, 300, 450, 653, and 1,240 feet long, respectively. The Cornucopia was under examination by a company with an option to operate it and near-by properties in Grant County; no development was undertaken except cleaning up a few drifts. Placer ground on Pine Creek, tributary to Burnt River, was leased by the Montana Mines (Inc.), and a dredge was under construction for operation in 1930. In the Mormon Basin region gold was recovered from surface mines in the vicinity of Rye Valley. The Emigrant drift placer at the head of Chicken Creek and the Three Cent placer near Sumpter yielded small amounts of gold bullion.

COOS COUNTY

Black sands of the present shore line and of the beach level about three miles inland produced gold and metals of the platinum group by sluicing. The output was only $220 in gold and silver and about $100 in platinum and iridium. The principal operations were on the Pioneer, otherwise known as the Lane or Randolph beach sand deposits. Prospectors working near Powers reported a little gold.

CURRY COUNTY

The total output of gold and silver in Curry County in 1929 was valued at $38,477, a slight increase over the value in 1928. Most of this output was reported from lode mines, of which the Robert E. Gold Mining Co. was the principal producer. This property, according to the June 18, 1929, edition of Mining Truth, Spokane, Wash., is profitably operating a quartz vein at the mouth of Babyfoot Creek on the Chetco River, near the town of Gold Hill. A wagon road down the Illinois River to Mountain Rest is within 9 miles of the Robert E. claim, but these 9 miles must be made over a pack trail. It is said that this property produced one-fifth of the gold reported from Oregon mines in 1928. Some of the richest quartz is shipped to the Selby smelter in California, one lot of 1,615 pounds netting $6,541.39. The ore body is developed for about 3,000 feet and is reported to be 18 inches to 14 feet in width.

Ocean beach sands were worked in the Sixes River district, south of Cape Blanco Light, and gold and metals of the platinum group were produced. On Boulder Creek in the vicinity of Agness the White Elephant placer was under development, during which some specimen gold was sold.

DOUGLAS COUNTY

Four placers and two lode mines in Douglas County in 1929 produced gold, silver, and copper valued at $39,719 compared with $22,188 in 1928. The chief value was in the copper yield, of which there was 188,197 pounds, valued at $33,123. The copper ore also was the principal source of the gold and silver output credited to the county. Placers along Cow Creek yielded a little gold.

At the Banfield property near Riddle about 400 tons of copper ore was mined in 1929, but because of a water shortage when the new 50 to 75 ton crushing plant with table concentration was completed, only 30 tons of 15 per cent copper concentrates was milled. No output was reported. The first six months of the year the Silver Peak mine in the same district was operated by Lotz, Larsen, and Elliott, then for two months under the name of the Silver Peak Mining & Milling Co., and from September to the end of the year by the Silver Peak Copper Co. (Inc.). The ore from the Silver Peak contained gold, silver, copper, and zinc; the zinc, however, is unpaid for.

GRANT COUNTY

The value of the metals produced from 5 lode mines and 14 placers in Grant County in 1929 was $85,978, or $11,792 less than in 1928. The output of the lode mines was $34,896 in gold, 20,573 ounces of silver, 2,040 pounds of copper, and 20,180 pounds of lead. The placers produced $38,356 in gold and 245 ounces of silver.

Of the producing lode mines the Buffalo in the Granite district was the principal producer. In 1929 the company shipped 249 tons of concentrates, averaging 6.06 ounces of gold and 80.6 ounces of silver to the ton, with a small percentage of copper and lead. Payment was made when the concentrates contained 3 per cent or more of lead. The property is equipped with a 20-ton flotation mill and the concentrates are shipped to the copper smelter at Tacoma, Wash., and the Bunker Hill lead plant at Bradley, Idaho. The Buffalo mine has produced steadily for three years. It is opened by several crosscut tunnels; about 500 feet of drifting was done in 1929. The ore is ground in a ball mill, and the overflow from classifier to flotation cells and tailings is recleaned on Frue vanners. The ratio of concentration is about 12 to 1. At the La Belleview and Independence mines in the Granite district work consisted of cleaning out the old workings for examination; no production of ore was attempted. Gold bullion was recovered from about 280 tons of ore treated in the 5-stamp amalgamation mill of the Rabbit mine in the Greenhorn district. The Golden Gate Mining Co. operated a 10-stamp amalgamation mill on its property at Susanville and produced some gold.

The most active and productive placer operations in the county were those in the Canyon district, especially in the upper drainage basin of the South Fork of the John Day River. Operating for two months, the Quartz Gulch Mining Co. with one giant hydraulicked about 4,000 cubic yards of material. The Empire dredge of the Empire Gold Dredging Co. was also productive. This company began dredging in June, 1916, and the dredge was constructed and floated within the corporation limits of the town of John Day, working up Canyon Creek toward Canyon City. After this field was exhausted the field west of Prairie City in the John Day River proved by extensive drilling a yardage sufficient for 10 or 12 years of operation. The dredge was recently dismantled and reconstructed on the new ground which, according to a printed article,[5] is worked at a cost of less than 5½ cents a yard. The dredge is of the Bucyrus type, completely equipped electrically with 75 six-cubic foot buckets and excavates to a depth of 30 feet. The total output recovered since the beginning of operations is stated to be about $1,750,000 in gold. In 1929 the dredge handled 292,500 cubic yards of material, working 3,000 yards a day in three 8-hour shifts. At the Sunshine placer, 2 miles south of Canyon City, about 300 yards of dirt was groundsluiced; the bullion here is 0.922 fine. The Granite district was credited with many small lots of placer gold, aggregating 58 fine ounces, reported by dealers who did not give information as to source. Pierson Bros. in the Susanville district sluiced about 1,500 yards of material from drift mining on the ancient river channel worked from Bear Creek, and produced about 25 ounces of gold with a fineness of 0.884.

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[5] Dismantling and Rebuilding a Gold Dredge: Eng. and Min. Jour., vol. 128, 1929, pp. 736-737.

JACKSON COUNTY

Jackson County was first in rank in the value of the metals produced in 1929; the production came from six lode mines and 25 placers. The principal operation in the county was that of the Rogue River Gold Co., operating an electric dredge on Foots Creek the entire year. No large production of gold from hydraulic mining was reported.

In the Upper Applegate district the Roosevelt claim of the El Senora group was opened by 130 feet of tunneling, during which some gold, 0.784 fine, was recovered from 25 tons of ore. Some very rich gold ore was found on the claim adjoining the Sylvanite group in the Gold Hill district. The Discon Gold Mining Co. developed the Sylvanite, which has a 10-stamp amalgamation mill. Pocket mining on the Star claim in the Jacksonville district resulted in a small lot of gold ore which was treated in a hand mortar. In the same district the Sterling and Sturgis hydraulic properties were active. Near Applegate the Layton placer of the Pacific Placer Co. was worked intermittently with two giants by lessees. Work consisted mostly of prospecting and opening new ground. The Huston placers near Central Point on Lane Creek were worked by groundsluicing, as there was not enough water to operate a giant. Miscellaneous small lots of gold, aggregating 127 fine ounces, were sold to dealers by producers of placer gold from the Jacksonville district. The Opp Mining Co. did 300 feet of drifting and tunneling at its property near Jacksonville; the gold discovered on this property has occurred in pockets, and the company hoped that systematic work would lead to some good veins. At the White Horse mining claims near Medford development work was carried on; it was planned to equip the 5-stamp amalgamation and concentration plant with oil flotation during 1930.

JOSEPHINE COUNTY

Seventeen lode mines and 34 placer operations in Josephine County in 1929 produced gold, silver, and copper valued at $133,681, an increase of $78,093 compared with 1928.

The Humdinger mine on Williams Creek in the Lower Applegate district was under development and its 2-stamp amalgamation mill operated a short time in April, June, and November. The mine is opened by a 200-foot tunnel and a 45-foot shaft. In the Galice district the Robertson Gold Mine (Inc.) treated about 400 tons of gold ore in its 10-stamp amalgamation mill, to which an addition of concentration equipment is expected in 1930. The mine is opened by a tunnel 540 feet long and by 800 feet of drifts. On Peavine Mountain, 5 miles northwest of Galice, is the Sun Flower mine, a gold property equipped with an Ellis ball mill in which ore was treated in 1929. Many small lots of gold were deposited with merchants and banks who reported that it came from various sources, such as the Lower Illinois River and the Althouse, Galice, and Grave Creeks. About 100 ounces of fine gold was credited to quartz mines in the Waldo or Kerby district. At Takilma an important new development was made on the Queen of Bronze mine, on which a 100-ton smelter was at one time operated. Of the ore mined about 2,000 tons, containing an average of $1.20 to the ton in gold and 10 per cent of copper, was sorted and shipped in 1929. The minerals found in the ore are chalcopyrite, pyrrhotite, and some pyrite. A 100-ton flotation mill has been planned. In the Louse Creek section the Edwards Mining Co. opened up the Black Jack, Wild Rose, and Buckskin claims on the Ida vein, a limestone ore body impregnated with pyrite and chalcopyrite containing gold. The mill is equipped with a flotation cell and table concentrator; the concentrates recovered were shipped to a smelter.

Placer mining in Josephine County was confined largely to the Waldo (or Kerby) district, which was credited with $17,143 in gold and 73 ounces of silver. The most important hydraulic mining was on the old beach gravels near O'Brien by the Llano De Oro Mines, which reported handling 110,000 cubic yards during the season of 105 days. The operations were carried on with two giants and two elevators, and the output consisted of gold bullion and native platinum. In the Galice district the Orazaba placers produced gold from about 1,700 cubic yards of material handled with two giants operating until in May.

LANE COUNTY

From the Bohemia district in Lane County some concentrates containing gold and a little lead were reported from the Noonday mine, 35 miles southeast of Cottage Grove. The property includes a mill equipped for amalgamation and gravity concentration. The Bartels mine produced gold bullion.

MALHEUR COUNTY

The Mormon Basin district, including Rye Valley and Malheur districts, was credited with the total output of metals in Malheur County in 1929 which came entirely from placer mining. At the Boswell placer ground, two giants between February and June handled about 30,000 cubic yards of material, and recovered a small lot of gold 0.867 fine. The Colt Bros. placer was also productive in a small way.

WALLOWA COUNTY

The production of metals in Wallowa County in 1929 came from the Magnet lode mine, 22½ miles southeast of Joseph. Ore assaying 5½ per cent copper was shipped to a smelter.

BAUXITE AND ALUMINUM [1]

By C. E. Julihn [2]

INTRODUCTION

In 1929 the aluminum and bauxite industries were characterized by continued increase of production and consumption, stable prices, expansion of established uses, and active research for the discovery of new uses.

WORLD PRODUCTION OF BAUXITE AND ALUMINUM

Bauxite production of the world as compiled by the Bureau of Mines from official reports amounted to 2,120,000 metric tons in 1929, compared with 1,994,000 tons in 1928. The production in 1929 includes 1,340,000 tons (more than 63 per cent of the total) from Europe, 398,000 tons (nearly 19 per cent) from South America, and 372,000 tons (17.5 per cent) from North America. Production in 1929 from Asia and Australia amounted to less than 0.5 per cent of the total.

World production of bauxite, 1925–1929, by countries, in metric tons

[Compiled under supervision of L. M. Jones, of the Bureau of Mines]

Country	1925	1926	1927	1928	1929
Australia: Victoria	------	------	936	196	555
British Guiana [1]	177,808	189,101	163,454	168,077	188,123
France	502,189	508,129	540,000	597,810	643,021
Germany	1,767	------	------	6,860	7,756
Greece	3,700	2,320	4,300	300	(2)
Hungary	390	3,667	339,464	395,974	389,152
India, British	10,232	5,036	4,379	14,902	9,189
Ireland, Northern	5,121	(2)	5,394	2,322	2,359
Italy	195,000	90,500	95,300	162,229	192,774
Rumania	------	745	1,706	653	926
Spain	------	------	------	181	975
Surinam (Dutch Guiana)	86,277	44,230	184,203	213,869	209,998
United States	321,620	398,546	326,091	381,452	371,648
Yugoslavia	79,032	131,828	100,327	49,264	103,366
	1,383,000	1,379,000	1,766,000	1,994,000	2,120,000

[1] Exports.

[2] Estimate included in total.

Aluminum was produced only in North America and Europe, a little more metal being furnished by the former than by the latter continent. North America contributed 132,000 metric tons and Europe 129,900 tons, a total of 261,900 tons in 1929, compared with 240,366 tons in 1928 and 212,931 tons in 1927.[3]

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[1] Work on manuscript completed December, 1930.

[2] Statistics on domestic production were prepared by H. W. Davis, and figures on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

[3] American Bureau of Metal Statistics, Year Book, 1929, p. 112.

RANK OF COUNTRIES IN PRODUCTION OF ALUMINUM AND BAUXITE

Considering aluminum and bauxite production by countries the United States leads all others in production of the metal, and France leads in production of bauxite. Six countries supplied 92 per cent of the total aluminum produced in the world in 1929; in order of output they are the United States, Germany, Canada, France, Norway, and Switzerland. Three countries—France, Hungary, and the United States—supplied 66 per cent of the total bauxite produced in 1929; four other countries—Dutch Guiana, Italy, British Guiana, and Yugoslavia—supplied 33 per cent. Of the 7 chief producers of bauxite and 6 chief producers of aluminum only 2 countries—the United States and France—appear in both groups, as the following table shows.

Rank of countries in production of aluminum and bauxite in 1929

Aluminum			Bauxite		
Rank	Country	Production (per cent of world total)	Rank	Country	Production (per cent of world total)
1	United States	38.98	1	France	30.33
2	Germany	12.03	2	Hungary	18.36
3	Canada	11.42	3	United States	17.53
4	France	11.07	4	Dutch Guiana	9.91
5	Norway	10.39	5	Italy	9.09
6	Switzerland	8.40	6	British Guiana	8.87
	Other countries (England, Italy, Austria, and Spain)	7.71	7	Yugoslavia	4.88
				Other countries	1.03
		100.00			100.00

NATURE OF BAUXITE

Aluminum is the most abundant metal in the earth's crust; in fact, the quantity is exceeded only by that of two other elements, oxygen and silicon. Throughout the world there is a great abundance of clays and other aluminous materials containing as much as 20 to 35 per cent of aluminum oxide, but such material, though theoretically a possible source of aluminum, is not likely to be utilized for commercial production of the metal as long as extensive deposits of bauxite containing 50 to 60 per cent of aluminum oxide remain available. Bauxite is therefore the only commercial ore of aluminum at present.

Bauxite is not a distinct mineral but a mixture of mineral substances, being usually a residuum of rock from which various constituents, especially silica, have been removed by natural leaching processes. Broadly speaking, rock in place that has been thus leached is called laterite; if it is sufficiently free from silica and if alumina predominates over other oxides of metals, it is called bauxite. Bauxite is relatively rare in comparison with the vast quantities of low-grade aluminous material available.

Typical bauxites now worked throughout the world contain less than 2 per cent silica, 10 to 30 per cent combined water, 55 to 65 per cent alumina, and 25 per cent to less than 1 per cent ferric oxide, together with 1 to 2 per cent titanium oxide. Bauxites of the United States and the Guianas are characterized by very high percentages of water, usually about 30 per cent; by a low percentage of ferric oxide, usually about 1 per cent; and by relatively high silica, usually about 2 per cent. The alumina averages about 60 per cent in the ores of the United States and somewhat higher in the ores of Guiana.

It has been estimated that about 75 per cent of the bauxite output is consumed in the production of aluminum, the remainder being consumed chiefly in the manufacture of cement, refractories, and abrasives, and for the filtering of oil.

MAKING ALUMINUM FROM BAUXITE

Aluminum is not smelted directly from the bauxite. It must first be extracted from the ore as an aluminum compound from which the metal aluminum is reduced in an electrolytic furnace, some of it being refined further.

Alumina (Al_2O_3), the aluminum compound used commercially for production of the metal, may be extracted from bauxite by several chemical processes, the Bayer alkaline process being used most extensively. This process readily eliminates iron and titanium but dissolves some silica, hence the necessity for low-silica content in bauxite for alkaline treatment. The acid processes are less effective in eliminating iron and titanium, but usually do not dissolve the silica in the bauxite. "Purified alumina suitable for the production of aluminum usually contains a total of less than 0.1 per cent of the oxides of iron, silicon, and titanium and is a highly refined product. The purification is a relatively expensive process."[4]

As approximately 2 tons of high-grade bauxite is required to make 1 ton of alumina, of which about 2 tons must be reduced to make 1 ton of metal, production of 1 ton of aluminum consumes about 4 tons of bauxite (usually somewhat less).

The economic status of aluminum is somewhat similar to that of nickel, as the industry is largely in the hands of a few great producers. Production is therefore readily correlated with demand, and prices remain relatively constant. In the last five years the world production of aluminum has expanded 57 per cent and domestic production 50 per cent.

Many new uses for aluminum have been developed in recent years, and relatively high prices for tin and copper have encouraged intensive research to effect substitution of aluminum for those metals. Aluminum is now employed extensively wherever lightness, durability, and strength are important. During 1929 new blooming and structural mills were completed at Massena, N. Y., to enlarge facilities for the output of strong alloys of aluminum. The size of structural elements made of aluminum and its alloys is increasing rapidly, due to more extended use of these metals in the superstructures of buildings and in the building of railroad coaches, airplanes, automobiles, and for other purposes.

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[4] Edwards, Junius D., and Mason, Ralph B., Aluminum Production in its Present-Day Aspects: Chem. and Met., vol. 36, No. 11, November, 1929, p. 674. (This is a valuable and succinct summary of processes.)

BAUXITE

DOMESTIC PRODUCTION—IMPORTS AND EXPORTS

In 1929 the bauxite output of the United States was 365,777 long tons, valued at $2,265,638, compared with 375,426 tons, valued at $2,273,898, in 1928. The decrease in quantity amounts to 2.6 per cent; that in value to 0.4 per cent. The decrease in output was more than balanced, however, by the increase of 10,134 tons in net imports, so the total supply of bauxite remained practically unchanged, amounting to 613,038 tons in 1929, compared with 612,553 tons in 1928. Imports of bauxite in 1929 aggregated 380,812 long tons, valued at $1,753,840, compared with 350,111 tons, valued at $1,534,498, in 1928, an increase of 9 per cent in quantity. Exports in 1929 amounted to 133,551 long tons, valued at $3,926,283, compared with 112,984 tons, valued at $5,210,912, in 1928, an increase of 18 per cent in quantity.

Bauxite produced in the United States, 1920–1929

Year	Georgia, Alabama, and Tennessee [1]		Arkansas		Total	
	Long tons	Value [2]	Long tons	Value [2]	Long tons	Value [2]
1920	40,029	$349,453	481,279	$2,897,892	521,308	$3,247,345
1921	14,700	134,400	124,850	755,400	139,550	889,800
1922	42,810	329,440	266,790	1,682,890	309,600	2,012,330
1923	28,810	176,030	493,880	2,980,580	522,690	3,156,610
1924	19,940	156,990	327,630	1,981,000	347,570	2,137,990
1925	20,220	109,800	296,320	1,878,450	316,540	1,988,250
1926	20,680	116,650	371,570	2,298,550	392,250	2,415,200
1927	17,110	95,920	303,830	1,892,860	320,940	1,988,780
1928	14,190	80,668	361,236	2,193,230	375,426	2,273,898
1929	14,723	84,480	351,054	2,181,158	365,777	2,265,638

[1] No production from Alabama in 1924, 1925, and 1926, and none from Tennessee in 1927 and 1929.

[2] Value f.o.b. mines.

Bauxite imported into and bauxite and bauxite concentrates exported from the United States, 1920–1929

Year	Imports for consumption		Exports (including bauxite concentrates)	
	Long tons	Value	Long tons	Value
1920	42,895	$251,284	22,257	$1,843,596
1921	27,587	164,589	5,942	488,785
1922	23,656	93,805	19,617	961,208
1923	119,020	593,882	78,560	3,380,486
1924	201,974	909,493	77,065	3,979,832
1925	353,696	1,549,120	78,633	4,134,455
1926	281,644	1,187,497	87,770	4,741,260
1927	356,580	1,572,236	121,858	7,800,491
1928	350,111	1,534,498	112,984	5,210,912
1929	380,812	1,753,840	133,551	3,926,283

Bauxite was produced in Alabama in 1929 from the Eufaula and "Lennig" mines in Barbour County and the Davis Hill No. 3 mine in Henry County. Shipments were 70 per cent greater than in 1928; about half was shipped for use in the abrasive industry and about half for use in the chemical industry.

Bauxite was produced in Georgia in 1929 at the Dupont mine in Floyd County and the Lane McMichael mine in Macon County. Shipments were 53 per cent less than in 1928; all was shipped for use in the chemical industry.

Bauxite was produced in Arkansas in 1929 at five mines—the Sweet Home, Dixie No. 2, and Hoekstra mines in Pulaski County and the Bauxite and Superior mines in Saline County. Shipments were 351,054 long tons, a decrease of 3 per cent from 1928. The main production originated in the Saline County field, where there was a decrease of 5 per cent, but the mines in Pulaski County also shipped important quantities, the increase over 1928 being 8 per cent. The shipments from Arkansas were mainly for use in the aluminum industry, followed in order by the abrasive, chemical, and refractory industries.

Some alumina obtained several years ago as a by-product in the treatment of alunite for its potash content at Marysvale, Utah, was sold in 1929 for use in refractories.

TOTAL BAUXITE PRODUCTION OF THE UNITED STATES

The first bauxite produced in the United States was obtained in 1889 from deposits in the north Georgia field, and in 1891 bauxite was first produced from the Alabama deposits. Practically all the bauxite mined in the United States until 1899 came from these two States. In 1896 the first shipments were made from Arkansas deposits, but it was not until 1900 that their influence was felt. In 1907 bauxite from the Tennessee deposits was first shipped. The total production of bauxite recorded in Mineral Resources from 1889 to 1929, inclusive, is 7,499,787 long tons.

ECONOMIC SETTING OF DOMESTIC PRODUCTION

Domestic production of bauxite is limited by competition from the high-grade bauxite of British and Dutch Guiana, which can be readily shipped by water direct to north Atlantic ports for consumption by the chemical industries or by way of New Orleans and the Mississippi River by water or rail to the interior as far as St. Louis for treatment and reshipment of concentrates. This fact limits the mining of domestic bauxite to deposits where the conditions for exploitation, including quality of ore and costs of mining and shipment, are exceptionally favorable. A substantial part of the high-grade domestic bauxite reserves is owned by aluminum-manufacturing interests which tend to relate their own domestic production to general plans that include provision for imports from Guiana and maintenance of domestic bauxite supply at an amount determined by plant capacity for treatment.

According to a communication to the Bureau of Mines bauxite was imported from British and Dutch Guiana during 1929 at an average rate of 32,000 long tons per month, compared with 30,800 tons per month in 1928. Most of this bauxite was entered at Gulf ports.

The international character of the aluminum industry is emphasized further by the utilization of available Canadian water power by manufacturing interests for the production of alumina and aluminum. In 1929 more than 94 per cent of the exports, described officially as "Bauxite and other aluminum ores and concentrates," from the United States went to Canada by way of the Great Lakes ports, almost all the rest having gone to Norway by way of New Orleans. In the two previous years more than 88 per cent of such exports went to Canada and practically all the rest to Norway. Although Canada is not a producer of bauxite the manufacture of aluminum from raw materials imported from the United States has been carried on at Shawinigan Falls, Quebec, since 1903. Recently a new plant was built at Arvida, near Lake St. John, on the upper reaches of the Saguenay River.

> Both plants still use bauxite from the United States but it is expected that the Arvida plant, because of its accessibility to tidewater, will be able to bring in its raw materials more cheaply by water from British Guiana than is now possible by rail from United States mines.[5]

The report cited shows furthermore (p. 148) that imports from the United States prior to 1928 consisted of alumina which was probably extracted at East St. Louis partly from foreign ore barged up the Mississippi from New Orleans. In 1928 Canadian imports of alumina dropped to 33,000 tons from 126,000 tons in 1927. This drop in Canadian imports of alumina was more than compensated for by Canadian importation of 130,000 tons of bauxite, a considerable part of which must have originated elsewhere than in the United States, presumably in Guiana.

PRICE

As the largest consumers of bauxite in the United States are also producers, only a small market exists for what might be called "outside bauxite." Consumers who do not own deposits contract for their supplies for considerable periods, apparently to assure an adequate supply of bauxite of the grade desired. The price of bauxite at mines or shipping points in 1929, as reported by producers, ranged from $5 to $8.50 a ton; the average price reported by all producers for the year was $6.19 a ton f. o. b. mines. Consumers, on the other hand, report prices for domestic bauxite that average $12.35 a ton f. o. b. plants. The price at consuming plant varies with the distance from mines, and transportation charges are the chief element in the difference in cost reported.

The price of bauxite is quoted in the Engineering and Mining Journal. "No. 1 chemical ore, crushed and dried, 55 to 58 per cent Al_2O_3 and 1.5 to 2.5 per cent Fe_2O_3," was quoted at $7.50 to $8.25 a long ton f. o. b. Alabama and Arkansas mines. Dalmatian low-silica bauxite was quoted at $4.80 to $6.50 a metric ton c. i. f. Atlantic ports; Istrian, $5.50 to $7; and French red bauxite, $6 to $8.

Under the tariff act of 1930 crude bauxite is dutiable at the rate of $1 a ton, and alumina hydrate or refined bauxite at one-half cent a pound. (See par. 6, Schedule 1, and par. 207, Schedule 2.)

MARKET

Bauxite finds its market east of the Mississippi River and is sold chiefly to the manufacturers of aluminum, abrasives, commercial chemicals, and refractories. The manufacturers of alumina cements are largely supplied by imported bauxite. High-alumina (diaspore) clays produced in Missouri are now used in the manufacture of refractories and are sold according to their alumina content; three grades containing 55, 65, and 70 per cent of alumina (Al_2O_3) are regularly handled. Information on production will be found in the Mineral Resources report on Clay.

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[5] Dominion Bureau of Statistics, Mineral Production of Canada, 1928, p. 147.

Some of the makers of refractories and of aluminum chemicals are using increasing quantities of clay as a crude material in place of bauxite.

Domestic bauxite was reported as sold in 1929 to the consuming industries shown in the table that follows. In comparison with 1928 sales of domestic bauxite to the aluminum industry decreased 21 per cent, but those to manufacturers of aluminum salts increased 3 per cent and those to makers of artificial abrasives increased 37 per cent.

Domestic bauxite sold by producers to industries in the United States, 1920–1929, in long tons

Year	Aluminum	Chemical	Abrasive[1]	Cement and refractory[1]	Total
1920	383, 154	85, 878	52, 276	(1)	521, 308
1921	91, 700	41, 000	6, 850	----------	139, 550
1922	211, 560	78, 540	19, 270	230	309, 600
1923	380, 520	68, 870	72, 830	470	522, 690
1924	225, 780	54, 870	66, 400	520	347, 570
1925	173, 040	67, 420	73, 720	260	314, 440
1926	241, 850	77, 960	72, 710	230	392, 250
1927	186, 490	62, 410	71, 790	250	320, 940
1928	218, 398	83, 992	72, 931	105	375, 426
1929	172, 807	86, 419	99, 925	6, 626	365, 777

[1] Small quantity of bauxite sold to makers of refractories probably included under "Abrasive."

The increase in bauxite sold to manufacturers of cement and refractories from 105 tons in 1928 to 6,626 tons in 1929 is probably attributable to the domestic manufacture of aluminous cement. Imports of such cement were introduced into the United States several years ago and have been received favorably. In this use of bauxite there are large possibilities for expansion.

For a number of years it has been impossible to give separate statistics showing the output of either artificial aluminous abrasives or refractories. Some measure of the combined output of these materials made from bauxite may be had from the quantity of bauxite sold to manufacturers, as indicated in the preceding table.

Value of aluminum and aluminum salts made from bauxite in the United States, 1920–1929

Year	New aluminum	Aluminum salts	Year	New aluminum	Aluminum salts
1920	$41, 375, 000	$9, 968, 200	1925	$36, 430, 000	$13, 155, 790
1921	10, 906, 000	7, 547, 200	1926	37, 583, 000	13, 202, 010
1922	13, 622, 000	8, 813, 000	1927	39, 266, 000	14, 288, 430
1923	28, 305, 000	8, 987, 400	1928	47, 899, 000	13, 990, 264
1924	37, 607, 000	9, 301, 400	1929	51, 864, 000	11, 677, 728

BAUXITE PRODUCERS IN THE UNITED STATES IN 1929

Wm. J. Crouch Mining Co., Adairsville, Ga.
Dixie Bauxite Co., Sweet Home, Ark.
Kalbfleisch Corporation, 535 Fifth Avenue, New York, N. Y.
Charles Lennig & Co. (Inc)., 222 West Washington Square, Philadelphia, Pa.
Republic Mining & Manufacturing Co., 230 Park Avenue, New York, N. Y.
Superior Bauxite Co., Joliet, Ill.

CONSUMERS OF BAUXITE IN THE UNITED STATES IN 1929

Aluminum Ore Co., East St. Louis, Ill.
Armour Fertilizer Works, Cincinnati, Ohio.
Atlas Portland Cement Co., 25 Broadway, New York, N. Y.
Bureau of Water Supply, Baltimore, Md.
Calumet Chemical Co., Joliet, Ill.
The Carborundum Co., Niagara Falls, N. Y.
Central Chemical Co., Kokomo, Ind.
City of Columbus Purification Works, Columbus, Ohio.
Exolon Co., Blasdell, N. Y.
General Abrasive Co., Niagara Falls, N. Y.
General Chemical Co., 40 Rector Street, New York, N. Y.
General Refractories Co., Trinity Building, New York, N. Y.
Grasselli Chemical Co., Cleveland, Ohio.
Gulf Refining Co., Frick Building Annex, Pittsburgh, Pa.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
Kalbfleisch Corporation, 535 Fifth Avenue, New York, N. Y.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Charles Lennig & Co. (Inc.), 222 West Washington Square, Philadelphia, Pa.
Massillon Stone & Fire Brick Co., Massillon, Ohio.
Merrimac Chemical Co., 148 State Street, Boston, Mass.
Metropolitan Utilities District, Omaha, Nebr.
Norton Co., Worcester, Mass. (also Niagara Falls, N. Y.).
Passaic Cons. Water Co., 158 Ellison Street, Paterson, N. J.
Pennsylvania Salt Manufacturing Co., Widener Building, Philadelphia, Pa.
Sacramento Filtration Works, Sacramento, Calif.
Stauffer Chemical Co., 624 California Street, San Francisco, Calif.
Superior Chemical Co., Joliet, Ill.
Water Department of Kansas City, Kansas City, Mo.
Welch Chemical Co., 8 East Long Street, Columbus, Ohio.

BENEFICIATION OF BAUXITE

In 1929 the United States Bureau of Mines published Bulletin 312, Bauxite: Float-and-Sink Fractionations and Flotation Experiments, by B. W. Gandrud and Fred De Vaney, based upon research in cooperation with the University of Alabama. The results obtained with samples of bauxite from Georgia, Alabama, Tennessee, Arkansas, and Mississippi gave little promise of elimination of silica by means of specific gravity, as the silica was generally contained in kaolinite of nearly the same specific gravity as that of the valuable content of aluminum hydrate.

Reduction of the quantity of iron proved practicable with some ores in which the iron could be liberated without fine crushing. Many bauxites containing up to 20 per cent Fe_2O_3 permitted fairly good recovery of concentrates containing less than 10 per cent Fe_2O_3. Some bauxites having less than 10 per cent Fe_2O_3 were tabled to yield concentrates containing less than 3 per cent.

ALUMINUM

DOMESTIC PRODUCTION—IMPORTS AND EXPORTS

New aluminum produced in the United States in 1929 amounted to 225,000,000 pounds (112,500 short tons), valued at $51,864,000, an increase of 7 per cent in quantity and 8 per cent in total value compared with 1928. According to statistics collected by J. P. Dunlop, of the Bureau of Mines, 48,400 short tons of secondary aluminum was recovered in 1929—25,850 tons as metal and 22,550 tons as the aluminum content of casting alloys. The combined domestic production of new aluminum and of secondary aluminum recovered as metal and in alloys thus amounted to 160,900 tons, 70 per cent of the total being new metal and 30 per cent secondary or recovered material.

Aluminum imports increased 22 per cent in total value—from $8,873,475 in 1928 to $10,860,009 in 1929; exports increased 16 per cent—from $6,891,490 in 1928 to $7,971,085 in 1929.

Quantity and value of aluminum produced in the United States and value of aluminum imported and exported, 1920–1929

Year	Domestic production				Imports[2]	Exports[3]
	Primary metal		Secondary metal[1]			
	Pounds	Value	Pounds	Value		
1920	138,000,000	$41,375,000	31,000,000	$9,489,100	$13,077,022	$5,630,781
1921	55,000,000	10,906,000	17,800,000	3,775,400	8,889,791	3,108,857
1922	74,000,000	13,622,000	32,580,000	6,085,900	9,695,012	2,836,116
1923	129,000,000	28,305,000	42,600,000	10,824,600	8,742,563	3,571,539
1924	150,000,000	37,607,000	54,000,000	14,596,200	7,145,036	4,172,390
1925	140,000,000	36,430,000	88,000,000	24,816,000	10,106,767	6,057,071
1926	145,000,000	37,583,000	88,400,000	23,868,000	16,779,377	4,452,303
1927	160,000,000	39,266,000	92,400,000	23,469,600	14,201,978	6,307,421
1928	210,000,000	47,899,000	95,600,000	22,848,400	8,873,475	6,891,490
1929	225,000,000	51,864,000	96,800,000	23,135,200	10,860,009	7,971,085

[1] Value of secondary aluminum based on average price at New York as given by American Metal Market.
[2] Imports for consumption include aluminum in crude form, scrap, bars, strips, rods, plates, sheets, and all manufactures of aluminum.
[3] Exports include ingots, metal and alloy, plates and sheets, and all manufactures of aluminum.

Imports of aluminum metal, scrap, alloy, etc., increased 31 per cent in quantity in 1929 compared with 1928. Imports of plates, sheets, bars, etc., decreased 15 per cent in quantity in 1929, and imports of hollow ware decreased 14 per cent. Imports of manufactures of aluminum other than hollow ware increased 15 per cent in value in 1929, compared with imports of similar products in 1928.

Aluminum imported for consumption in the United States, 1928 and 1929, by classes

Class	1928		1929	
	Pounds	Value	Pounds	Value
Crude and semicrude:				
Crude form, scrap, alloy, etc.	38,822,504	$8,046,831	50,858,523	$9,925,855
Plates, sheets, bars, strips, rods, coils, and blanks	23,924	10,083	20,450	7,578
Circles, disks, rectangles, and squares	579	193	1,850	1,290
	38,847,007	8,057,107	50,880,823	9,934,723
Manufactures:				
Leaf (5½ by 5½ inches)	(1)	36,754	(1)	39,521
Powder, powdered foil	306,906	115,920	377,040	138,182
Foil less than 0.006 inch thick	848,317	474,066	1,141,718	568,587
Table, kitchen, and hospital utensils and other similar hollow ware	146,959	75,737	126,100	70,295
All other manufactures	(2)	113,891	(2)	108,701
		816,368		925,286
Grand total		8,873,475		10,860,009

[1] 1928: 26,631,248 leaves; 1929: 29,093,849 leaves; equivalent in pounds not recorded.
[2] Quantity not recorded.

Exports of aluminum ingots, scrap, and alloys decreased 74 per cent in quantity in 1929 compared with 1928. Exports of tubes, moldings, castings, and other shapes increased 146 per cent, and exports of plates, sheets, bars, etc., increased 23 per cent. The value of table, kitchen, and hospital utensils exported increased 10 per cent in 1929, and that of "other manufactures of aluminum" increased 14 per cent.

Domestic aluminum exported from the United States, 1928 and 1929, by classes

Class	1928		1929	
	Pounds	Value	Pounds	Value
Crude and semicrude:				
Ingots, scrap, and alloys	2,390,498	$443,895	613,366	$117,345
Plates, sheets, bars, strips, and rods	13,337,783	3,314,833	16,418,751	4,032,194
	15,728,281	3,758,728	17,032,117	4,149,539
Manufactures:				
Tubes, moldings, castings, and other shapes	1,003,957	398,250	2,466,508	738,376
Table, kitchen, and hospital utensils	(1)	643,205	(1)	708,467
Other manufactures of aluminum	(1)	2,091,307	(1)	2,374,703
	(1)	3,132,762	(1)	3,821,546
Grand total	(1)	6,891,490	(1)	7,971,085

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[1] Quantity not recorded for table, kitchen, and hospital utensils and other manufactures.

From the preceding tables of imports and exports in 1929 it appears that the total imports for which the weights are recorded amounted to 26,263 short tons and the total exports to 9,749 tons. The excess of imports over exports thus accounted for amounts to 16,514 tons, indicating an approximate total supply of 177,414 tons of aluminum for domestic consumption. Nearly 58 per cent of this total represents new domestic production, more than 27 per cent represents secondary or recovered material, and nearly 15 per cent represents imports.

PRICE

According to the Engineering and Mining Journal the domestic price of new aluminum ingot 99 per cent pure was 24.3 cents a pound during the entire year 1929. Prices in the outside market for metal 98 to 99 per cent pure held throughout the year at 23.9 cents a pound.

ALUMINUM SALTS

Manufacturers of aluminum salts reported a consumption of 142,344 long tons of bauxite in 1929, having an average value of $13.44 a ton at the plant, compared with 141,310 tons in 1928, with an average value of $13.04 a ton. Of the bauxite consumed in 1929, 80,024 tons was domestic bauxite, valued at $988,005, and 62,320 tons was imported bauxite, valued at $924,571. An unrecorded quantity of high-alumina clay, 3,950 short tons of alumina hydrate, and 402 short tons of aluminum were also used in the preparation of aluminum salts. These figures do not include the bauxite made into alumina as a preliminary step in the manufacture of aluminum.

Aluminum salts produced in the United States, 1928 and 1929

Salt	1928				1929			
	Number of producers reporting	Short tons	Value		Number of producers reporting	Short tons	Value	
			Total	Average			Total	Average
Alum:								
Ammonia	6	5,018	$292,767	$58	5	5,108	$286,592	$56
Sodium	3	15,718	845,709	54	3	15,005	855,754	57
Potash	2	(1)	(1)	(1)	3	6,304	254,290	40
Other					1			
Aluminum chloride:								
Liquid	4	2,403	126,236	53	4	2,399	127,935	53
Crystal	3	372	44,644	120	3	365	43,148	118
Anhydrous	3	13,995	3,708,094	265	3	13,787	1,429,743	104
Aluminum sulphate:								
Commercial—								
General	12	311,775	7,538,084	24	11	319,736	7,589,244	24
Municipal	6	8,444	152,373	18	6	8,190	126,550	15
Iron-free	7	23,940	820,945	34	6	20,441	731,732	36
Other aluminum salts and hydrate	[2] 4	[1] 5,240	[1] 461,412		[2] 5	2,758	232,740	
		386,905	13,990,264			394,093	11,677,728	

[1] Potash alum produced in 1928 included under "Other aluminum salts and hydrate."
[2] 1928: 2 producers each of alumina and sodium aluminate; 1929: 2 producers each of alumina and sodium aluminate and 1 producer of aluminum stearate.

Aluminum salts produced in, imported into, and exported from the United States, 1920–1929

Year	Domestic production		Imports		Exports (aluminum sulphate) [1]	
	Short tons	Value	Short tons	Value	Short tons	Value
1920	258,009	$9,968,174	1,340	$69,896	(2)	(2)
1921	184,813	7,547,184	1,009	45,963	(2)	(2)
1922	281,480	8,812,987	2,889	116,971	13,225	$388,447
1923	289,904	8,987,421	2,318	120,663	17,805	505,732
1924	302,190	9,301,410	2,523	113,075	16,012	407,749
1925	335,480	13,155,790	3,205	140,518	20,756	505,537
1926	373,695	13,202,010	2,937	140,994	22,031	521,123
1927	378,770	14,288,430	1,845	83,288	21,128	491,317
1928	386,905	13,990,264	1,425	68,096	[1] 22,713	[1] 552,342
1929	394,093	11,677,728	1,912	86,411	[1] 26,588	[1] 607,757

[1] Also 418 short tons of "other aluminum compounds," valued at $85,809, exported in 1928, and 275 tons, valued at $65,458, exported in 1929; not separately classified prior to 1928.
[2] Exports not separately shown prior to 1922.

ALUMINOUS ABRASIVES AND REFRACTORIES

The use of aluminous abrasives and high-alumina refractories continues to grow. Makers of artificial abrasives took 99,925 long tons of domestic bauxite in 1929. Expansion is shown by the increasing demand for high-alumina clays and other aluminous minerals by ceramists all over the country. In 1929 the makers of refractories took 71,589 short tons of high-alumina (diaspore) clay. Alumina by-product, amounting to nearly 1,500 short tons, was shipped from Marysvale, Utah, to California and New Jersey makers of refractories.

FOREIGN BAUXITE AND ALUMINUM INDUSTRIES[6]

NORTH AMERICA

CANADA

Canada produced 29,900 metric tons of aluminum in 1929, compared with 27,200 tons in 1928, 25,400 tons in 1927, and 13,600 tons in 1926. Exports of aluminum[7] amounted to 33,099 metric tons in 1929, compared with 18,414 tons in 1928. The destination of exports in 1929 was as follows: United States, 39 per cent; Japan, 24 per cent; United Kingdom, 17 per cent; other countries, 20 per cent.

Reduction works at Shawinigan Falls and Arvida, in Quebec, are owned by the Aluminum Co. of Canada, a subsidiary of Aluminum (Ltd.), which is a holding company for the Aluminum Co. of America.

The Aluminum Co. of Canada is expected to complete the first unit of its own hydroelectric plant at Chute-à-Caron in February, 1931.[8] This unit will generate 250,000 horsepower daily for use at the Arvida plant; the ultimate daily capacity of the plant will be 700,000 horsepower. The Arvida plant, consisting of a refinery for the treatment of bauxite, an electrode plant, and a reduction plant, will have a larger output of aluminum than any other plant in the world. Most of its production is expected to be required at Detroit for use in automobile manufacture.

The Sodalumina Chemical Corporation (Ltd.) of Canada[9] expects to undertake the extraction of alumina, soda ash, hydrochloric acid, silica, etc., from clay deposits by the Keogh process.

Canada.—*Production, imports, and exports of aluminum and imports of bauxite, alumina, and cryolite, 1925–1929, in metric tons*

Year	Aluminum			Bauxite and alumina imports[3]	Cryolite imports[3]
	Production[1]	Imports[2]	Exports[2]		
1925	11,800	314	12,368	57,836	684
1926	13,600	436	11,420	65,837	2,904
1927	25,400	506	23,542	114,865	1,110
1928	27,200	633	18,414	148,558	3,142
1929	29,900	386	33,099	129,449	2,178

[1] American Bureau of Metal Statistics, Year Book, 1929, p. 112.
[2] Metallgesellschaft, 1920–1929, p. 28.
[3] Imperial Institute, Statistical Summary, 1925–1927, 1926–1928, and 1927–1929.

GREENLAND

Greenland, the only source of natural cryolite, exported 29,780 metric tons in 1929, compared with 25,935 tons in 1928. Official Danish reports show 21,398 metric tons imported by Denmark in 1929. Imports into the United States for that year amounted to

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[6] Unless otherwise stated, figures for foreign production of bauxite are those shown in the world table on p. 485, compiled from official reports; those for aluminum are taken from the yearbooks of the American Bureau of Metal Statistics, Imperial Institute, or Metallgesellschaft. Exports and imports are taken from reports of the Imperial Institute, Metallgesellschaft, or Bureau of Foreign and Domestic Commerce, United States Department of Commerce.

[7] Metallgesellschaft, Stat. Zusammenst., 1920–1929, p. 28.

[8] Wall Street Journal, vol. 95, No. 122, May 27, 1930, p. 17.

[9] U. S. Bur. For. and Dom. Commerce, World Trade Notes, vol. 4, Jan. 27, 1930, No. 4.

7,903 metric tons. The cryolite sent to Copenhagen is refined there and reexported to other countries.

SOUTH AMERICA

BRITISH GUIANA

The production of bauxite in British Guiana amounted to 220,129 metric tons in 1929, compared with 200,891 tons in 1928 and 192,984 tons in 1927. Exports of bauxite amounted to 188,123 metric tons in 1929, compared with 168,077 tons in 1928 and 163,454 tons in 1927.

British Guiana.—*Production and exports of bauxite, 1925–1929, in metric tons*

Year	Production[1]	Exports	Year	Production[1]	Exports
1925	197,458	177,808	1928	200,891	168,077
1926	222,516	189,101	1929	220,129	188,123
1927	192,984	163,454			

[1] Imperial Institute, Statistical Summary (annual).

The principal company operating in British Guiana is the Demerara Bauxite Co. (Ltd.), a subsidiary of Aluminum (Ltd.), but the British & Colonial Bauxite Co. (Ltd) obtained a lease in 1929 on bauxite deposits up the Demerara River, in the vicinity of Christianburg.[10] From the beginning of exploitation in 1915 to the end of 1929, the Demerara company had shipped about 1,160,000 long tons of bauxite. Washers and dryers are now used for beneficiating the ore by removal of silica above 3 per cent. The process yields a 70 per cent recovery.

The bauxite deposits are similar to those of Dutch Guiana, occurring in small hills that rise above the coastal plain 60 to 80 miles from the coast and near the Demerara and Berbice Rivers. Average analysis of shipments is said to be as follows:[11] 61 per cent Al_2O_3; 2.75 per cent SiO_2; 2.5 per cent Fe_2O_3; 2.75 per cent TiO_2; and 31 per cent combined water.

DUTCH GUIANA

Surinam (Dutch Guiana) produced 209,998 metric tons of bauxite in 1929, compared with 213,869 tons in 1928, 184,203 tons in 1927, 44,230 tons in 1926, and 86,277 tons in 1925. Exports amounted to 215,795 metric tons in 1929, compared with 206,767 tons in 1928, 176,292 tons in 1927, 46,454 tons in 1926, and 86,826 tons in 1925. Of the 1929 exports 25,942 tons went to Canada and 180,825 tons to the United States.

Two important companies operate in Dutch Guiana—the Kalbfleisch Corporation and the Surinaamsche Bauxite Maatschappij (a subsidiary of the Aluminum Co. of America). In 1928 the latter shipped[12] nearly 190,000 tons of ore of all grades from its Moengo mine, which has a maximum plant capacity of about 200,000 tons annually. The ore deposits are near Paramaribo, along the Surinam, Cottica, and Coermotibo Rivers, extending from about 15 to 100 miles from the coast. They range in thickness from 10 or 12 feet in the south to as much as 50 feet in the north.

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[10] U. S. Bur. For. and Dom. Commerce, Foreign Trade Notes, No. 249, June 8, 1929.
[11] Edwards, J. D., Frary, F. C., and Jeffries, Zay, Aluminum and Its Production: 1930, p. 111.
[12] Engineering and Mining Journal, vol. 128, No. 12, Sept. 21, 1929, pp. 460–463.

The ores of Dutch Guiana run about 59 per cent Al_2O_3, 2 per cent SiO_2, 6 per cent Fe_2O_3, 3 per cent TiO_2, and 30 per cent water (combined). They resemble the ores of Arkansas except that they contain less SiO_2.

EUROPE

AUSTRIA

There are two aluminum-reduction works in Austria—the Aluminium Industrie (Neuhausen) at Lend-Gastein and Elektrizitätswerke Stern und Hafferl, A. G., at Gmunden, Oberösterreich, also known as the "Aluminiumwerke Steeg."

Austrian production of aluminum amounted to 3,700 metric tons in 1929, compared with 4,000 tons in 1928, 4,000 tons in 1927, 3,000 tons in 1926, and 3,000 tons in 1925. Exports[13] of aluminum amounted to 3,981 metric tons in 1929, compared with 4,038 tons in 1928, 4,243 tons in 1927, 3,575 tons in 1926, and 2,022 tons in 1925. Imports of aluminum amounted to less than 1,000 tons annually during this 5-year period. Exports went largely to Switzerland, Germany, Belgium, and Russia. Imports of aluminum oxide amounted to 8,100 metric tons in 1929, compared with 9,000 tons in 1928. In addition, about 2,000 tons of aluminum hydroxide is imported annually. Austrian reserves of raw materials are not large.

DENMARK

The aluminum industry of Denmark comprises importation of crude cryolite from Greenland for refining and exportation to other European countries. Imports of crude cryolite amounted to 21,398 metric tons in 1929, compared with 16,174 tons in 1928, 14,316 tons in 1927, 17,325 tons in 1926, and 22,424 tons in 1925. Exports of refined cryolite amounted to 18,120 metric tons in 1929, compared with 15,508 tons in 1928, 12,539 tons in 1927, 14,627 tons in 1926, and 17,425 tons in 1925.

Aluminous clays 2 meters thick, averaging 32 to 36 per cent alumina and amounting to several million tons, have been found north of Amundsfjord, in Iceland.

FRANCE

France produced 29,000 metric tons of aluminum in 1929, compared with 27,000 tons in 1928, 25,000 tons in 1927, 23,608 tons in 1926, and 18,408 tons in 1925. Exports of aluminum amounted to 2,190 metric tons in 1929, 3,080 tons in 1928, 6,747 tons in 1927, 868 tons in 1926, and 2,138 tons in 1925. Imports amount to a few hundred tons annually. The consumption of aluminum in 1929 was estimated by Metallgesellschaft at 25,000 metric tons.

French production of bauxite amounted to 643,021 metric tons in 1929, compared with 597,810 tons in 1928, 540,000 tons in 1927, 508,129 tons in 1926, and 502,189 tons in 1925. Exports of bauxite amounted to 240,415 metric tons[14] in 1929, compared with

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[13] Statistik des auswärtigen Handels Oesterreichs, October-December, 1929.
[14] Mining Journal, London, vol. 169, No. 4938, Apr. 12, 1930, p. 306.

250,755 tons in 1928, 262,339 tons in 1927, 184,003 tons in 1926, and 214,905 tons in 1925. Exports of hydrous alumina amounted to 35,400 metric tons in 1929, compared with 30,400 tons in 1928.

The French aluminum and bauxite industry is located chiefly on the east side of the Rhône Valley near the Alps and the boundaries of Switzerland and Italy. During recent years Var has been the center of bauxite production, followed by Hérault, Bouches-du-Rhône, and Ariège; in 1928 Var furnished 83 per cent and Hérault 16 per cent of the total.

As a result of successive consolidations only two great companies now produce aluminum in France. The Compagnie des Produits Chimiques et Electrométallurgiques Alais, Froges et Camargue has alumina works at St. Auban, Salindres, and Gardanne; it has reduction works at 10 different points, determined chiefly by available power. The Société d'Electrochimie, d'Electrométallurgie et des Aciéries Electriques d'Ugine, with alumina works at La Barasse, has reduction works at three different points. Both these dominant producers join in a third company, Aluminium Français, which serves as their sales organization and as a fabricator of aluminum.

GERMANY

Although Germany is said to have enough bauxite to supply its requirements for aluminum, if necessary, only a small production is made at present from the Vogelsberg and Osterburken mines; these mines produced 7,756 metric tons in 1929. Imports of bauxite, however, amounted to 386,972 metric tons in 1929, compared with 432,258 tons in 1928. France supplied 146,000 tons, Hungary 97,000 tons, Italy 72,000 tons, and Yugoslavia 68,000 tons in 1929.

German production of aluminum amounted to 32,700 metric tons in 1929; net imports were about 10,000 tons. Metallgesellschaft estimates a consumption of 39,000 tons.

Alumina works are located at Lautawerk, Duisburg, Breslau, Bergheim, and Ludwigshafen and aluminum-reduction works at Lautawerk, Innwerk, Grevenbroich, Bitterfeld, and Rheinfelden. A considerable part of the electricity for German production of aluminum is generated from coal as cheap lignite is available.

GREECE

Deposits of bauxite are fairly widespread in the limestone regions of western Greece, and in recent years somewhat extended investigations have been been made to ascertain the probable value of the deposits. Similar occurrences have been found on the islands of Kimolos, Seriphos, and Melos, where, according to Pliny, alum was made as early as the first century. The production of bauxite declined to 300 metric tons in 1928, from 4,300 tons in 1927, 2,320 in 1926, and 3,700 tons in 1925. No report of the production in 1929 is yet available.

Greek deposits were recently acquired by the Otavi Minen und Eisenbahn Gesellschaft,[15] and in 1929 a joint holding company was formed,[16] in which the Otavi company joined equally with Vereinigte Aluminium Werke in Lautawerke and the Barlos Greek Bauxite Mines Co. The Barlos company has 17 valuable bauxite concessions at Distomon, Boeotia, Gulf of Corinth, Greece, four of which will be prepared for production.

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[15] Daily Metal Reporter (Int. Monthly Sec.), vol. 29, No. 54, March, 1929, p. 14.

HUNGARY

Hungary produced 389,152 metric tons of bauxite in 1929, compared with 395,974 tons in 1928, 339,464 tons in 1927, and 3,667 tons in 1926. Exports amounted to 100,549 metric tons in 1929, compared with 183,487 tons in 1928, and 228,504 tons in 1927. Bauxite exports to Germany amounted to 96,664 tons in 1929.

The bauxite deposits of Hungary are in the trans-Danube territory south and west of the Danube River. Several deposits in the Vertes Mountains near Gant, Zamoly, and Czakbereny are reported to have many millions of tons of ore in reserves.[17] These mines are connected at Bodajk with the Danube-Sabe-Adria Railway by an 18-kilometer branch road; systematic operation began in 1926. They are controlled by the Bauxite Trust, A. G., owned jointly by the Vereinigte Aluminium Werke, A. G., General Hungarian Coal Mining Co., Salgotariana Coal Co., and Otavi Minen und Eisenbahn Gesellschaft.

Recently, Hungarian deliveries to Germany declined, due to excessive accumulation of stock by the Vereinigte Aluminium Werke, which announced it would no longer take French ore but would meet its needs with Hungarian bauxite mined by the Bauxite Trust.[18]

In order to increase consumption of bauxite the Bauxite Trust, A. G., has been financing various aluminous cement projects[19] in Poland, Czechoslovakia, and Yugoslavia, and the Continental Bauxite Trust has confirmed a report[20] that it will support the construction in Hungary of an aluminum factory having a capacity of 1,600 tons a year.

The annual consumption of aluminum in Hungary is about 2,000 tons.

ITALY

Italy produced 192,774 metric tons of bauxite in 1929, compared with 162,229 tons in 1928 and 95,300 tons in 1927. Much of the output was exported, more than 71,000 tons going to Germany in 1929. Aluminum production amounted to 7,373 metric tons in 1929, compared with 3,618 tons in 1928 and 2,544 tons in 1927. Aluminum imports amounted to 2,386 metric tons in 1929 and exports to only 121 tons. The apparent consumption of aluminum in 1929 was thus about 9,600 tons.

In 1929 four companies were operating in Italy: Società dell' Alluminio Italiano, controlled by Aluminium (Ltd.) (subsidiary of Aluminum Co. of America), at Borgofranco (annual capacity 1,400 tons); Società Meriodionale di Elettricita (formerly Società di Elettricochimica, but now controlled by A. G. Aluminium Industrie Neuhausen), at Bussi, Aquila (annual capacity 1,000 tons); Società Anonima Veneta dell' Alluminio, at Porto-Maghenera (annual capacity 3,000 tons); and Società Italiana dell' Alluminio (subsidiary of Società

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[16] Engineering and Mining Journal, Aug. 18, 1929, p. 271.
[17] U. S. Bur. For. and Dom. Commerce, Foreign Trade Notes, No. 141, May, 14, 1927.
[18] Daily Metal Reporter (Int. Monthly Sec.), vol. 30, No. 58, pt. 2, Mar. 25, 1930, p. 15.
[19] Daily Metal Reporter (Int. Monthly Sec.), vol. 30, pt. 2, Jan. 31, 1930, p. 15.
[20] Daily Metal Reporter (Int. Monthly Sec.), vol. 29, No. 204, Oct. 22, 1929, p. 15.

Montecatini), at Mori, Trentino (annual capacity 6,000 tons). The Otavi Minen und Eisenbahn Gesellschaft has been negotiating[21] with the Montecatini company regarding joint exploitation of the latter's idle properties. The Lautawerke Co. has a plant for the extraction of alumina by the Haglund process at the Montecatini works, but reports indicate that the process has not yet been perfected.

The Società Alluminio Veneta has announced plans to produce 20,000 tons of alumina, 6,000 tons of aluminum, and 6,000 tons of electrodes.[22]

Reserves of bauxite in Italy have been estimated[23] at 13,600,000 metric tons—8,100,000 tons in Istria and 5,500,000 in Abruzzi—having a content of 40 to 63 per cent Al_2O_3. Three of the leading Istrian producers are controlled by American concerns.

In Italy there are extensive areas of leucite rocks near Leucite and Monti, and a considerable program for the utilization of leucite for production of alumina and potash is under development.[24]

It is estimated that 30,000 tons of aluminum and a large tonnage of potash may be produced from 1,000,000 tons of leucite rock. A first production unit at Aurelia, near Civitàvecchia in central Italy, will handle 20,000 tons of leucite annually. The ultimate annual capacity of the plant is planned to be 1,000,000 tons of leucite.[25]

NORWAY

Norway produces no bauxite. The following table shows the imports of raw materials and the production and exports of aluminum from 1925 to 1929.

Norway.—*Imports of bauxite, alumina, and cryolite and production and exports of aluminum, 1925–1929, in metric tons*

Year	Bauxite and alumina imports	Cryolite imports	Aluminum	
			Production	Exports
1925	45,676	2,379	21,300	20,549
1926	45,067	2,152	24,400	22,131
1927	42,650	1,954	20,847	22,077
1928	52,636	2,385	24,779	16,842
1929	67,677	2,301	27,200	29,813

The exports of aluminum in 1929 went to the United Kingdom (50 per cent), Russia (16 per cent), United States (15 per cent), Germany (6 per cent), Japan (5 per cent), Belgium (3 per cent), Sweden (2 per cent), and other countries (3 per cent).

The principal companies operating aluminum-reduction works include the following:

1. Aktieselskapet Stangfjordens Elektrokemiske Fabriker, at Stangfjord (owned by the British Aluminium Co.) (400 tons).
2. Aktieselskapet Vigelands Brug, at Vigelands (owned by the British Aluminium Co.) (3,000 tons).

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[21] Daily Metal Reporter, Mar. 20, 1929, p. 14.

[22] Mining Journal, London, vol. 166, No. 4900, July 20, 1929, p. 597.

[23] Redecker, S. B., Cons. Rept. 329,797 (7,563), Feb. 15, 1930, pp. 8–10.

[24] Mining Journal, London, vol. 168, No. 4924, Jan. 4, 1930, p. 18.

[25] Brett, Homer, Potash and Aluminum from Leucite: Cons. Rept. 322, 415 (10,760), Nov. 7, 1929, Milan, Italy.

3. Det. Norske Nitridaktieselskab, at Eydehavn and Tyssedal (owned by Compagnie A. F. C., British Aluminium Co., and Aluminium, (Ltd.)) (annual capacity, 15,000 tons in 1929).
4. Norsk Aluminium Co., at Höyanger (owned jointly by Norwegian interests and Aluminium (Ltd.)) (annual capacity, 6,500 tons).
5. A. S. Haugvik Smelteverk, at Glomfjord (annual capacity, 8,000 tons).

Norway is fortunate in possessing hydroelectric power sites on excellent harbors. The first production of aluminum was made in 1908. The total rated annual capacity in 1930 was about 36,000 tons, of which the subsidiaries of the Aluminum Co. of America produced a considerable part. The improvements now under way at various plants and the new plants at Kinsarwik and Glomfjord will increase the annual capacity to 65,000 tons.

RUMANIA

Rumania produced 926 metric tons of bauxite in 1929, compared with 653 tons in 1928, 1,706 tons in 1927, and 745 tons in 1926.

The Otavi Minen und Eisenbahn Gesellschaft has purchased bauxite properties in the Bihar Mountains of western Rumania.[26] These deposits are said to have from 2,000,000 to 10,000,000 tons of reserves in sight and possible extension to as much as 20,000,000 tons. The better grade of red ore runs 55.6 per cent Al_2O_3, 3 per cent SiO_2, 25.3 per cent Fe_2O_3, and 11 per cent moisture; a gray ore runs about 69 per cent Al_2O_3, 12 per cent SiO_2, 3 per cent Fe_2O_3, and 15 per cent water.

RUSSIA

Large deposits of bauxite have been developed in the Tikhvin, Riazan, and Perm districts. The Soviet Government plans to use these deposits as a basis for the erection of aluminum-reduction works at Svanka, Dnieper, and Moscow. The three works will be under French technical supervision, both as to construction and operation.

The Tikhvin region has 15 deposits which have been drilled sufficiently to indicate more than 8,000,000 tons[27] of reserves. The ore lies in a blanket 1 to 10 meters thick and 5 to 20 meters below the surface; a substantial part of the ore runs as high as 71 per cent alumina.

Preliminary to erecting a reduction plant near the Dnieper power station[28] in the Ukraine the Russians have been experimenting with processes. As planned, the plant will have an annual capacity of 10,000 to 15,000 tons of aluminum. The new plant on the Volkhov[29] near Svanka will have an annual capacity of 5,000 tons. The Moscow plant is expected to be chiefly a fabrication plant.

As Russian consumption of aluminum is about 6,000 tons annually[30] the new plants, when finished, would provide an exportable surplus.

Imports of aluminum into Russia[31] amounted to 5,132 metric tons in 1929, 5,793 tons in 1928, 2,840 tons in 1927,[32] and 1,796 tons in 1926.

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[26] Daily Metal Reporter (Int. Monthly Sec.), vol. 29, No. 54, March, 1929, p. 14.

[27] Anderson, R. J., The Russian Bauxite Deposits: Min. Mag., London, vol. 41, July and August, 1929, pp. 9-15 and 83-92.

[28] American Metal Market, vol. 37, No. 76, Apr. 18, 1930, p. 4.

[29] Daily Metal Reporter (Int. Monthly Sec.), vol. 30, pt. 2, Jan. 21, 1930, p. 12.

[30] Mining Journal, London, vol. 166, No. 4902, July 27, 1929, p. 618.

[31] Daily Metal Reporter, vol. 30, pt. 2, No. 97, May 20, 1930, p. 15.

[32] Ann. Rept. on the Mineral Resources of U. S. S. R., 1926-1927, Leningrad, 1928.

SPAIN

Spain produced 975 metric tons of bauxite in 1929, compared with 181 tons in 1928. Its annual consumption of aluminum amounts to about 1,500 metric tons.

Spain is the most recent country to enter the aluminum-producing field; the only works are at Sabiñánigo, Province of Huesca. The plant is operated by the Aluminio Español, S. A.; it has a rated capacity of 1,200 tons a year. Production of aluminum amounted to 1,500 metric tons in 1929 and 1,000 tons in 1928. Imports of alumina amounted to 2,500 metric tons in 1929.

SWITZERLAND

Switzerland does not produce bauxite but because of its water power produces considerable aluminum. The following table gives statistics of the Swiss aluminum industry.

Switzerland.—*Imports of alumina and production, exports, and consumption of aluminum, 1925–1929, in metric tons*

Year	Alumina imports	Aluminum		
		Production	Exports	Consumption
1925	(1)	21,000	13,862	7,500
1926	31,685	21,000	15,443	5,800
1927	40,323	20,000	13,393	7,000
1928	45,544	19,900	15,045	6,000
1929	42,201	20,700	13,212	8,000
Annual average	(1)	20,520	14,191	6,860

[1] Data not available.

Exports of aluminum from Switzerland in 1929 went to Germany (26 per cent), United Kingdom (21 per cent), United States (14 per cent), Japan (14 per cent), Belgium (10 per cent), Italy (6 per cent), and other countries (9 per cent).

The Swiss aluminum-reduction plants include:

1. Aluminium Industrie, A. G., or Société Anonyme pour l'Industrie de l'Aluminium, with plants at Neuhausen and Chippis (Neuhausen is just west of Lake Constance and Chippis is in southwest-central Switzerland). The latter is the more important.
2. Fabrique d'Aluminium Martigny, S. A., at Martigny-Bourg, in the Canton of Valais (on the French border west and south of Chippis works) (annual production about 1,800 tons).

The Neuhausen works ran continuously during 1929, notwithstanding a keen struggle for business. The Chippis works is an alloy plant that began operations during 1929.

UNITED KINGDOM

The only bauxite produced in the United Kingdom comes from Northern Ireland, near Belfast, at Larne Harbor, County Antrim. This source, however, has not been able to compete with foreign ores. The average annual production from 1925 to 1929, inclusive, amounted to about 3,800 tons, the output for 1929 being 2,359 metric tons.

The British aluminum industry is summarized in the following tables.

United Kingdom.—*Imports and exports of aluminum raw materials, 1925–1929, in metric tons*

	1925	1926	1927	1928	1929
Imports:					
Alumina	54	692	109	1,077	924
Bauxite	76,051	64,391	90,474	111,262	123,109
Cryolite	1,578	1,211	1,183	1,572	1,742
Exports: Alumina	12,894	13,109	11,598	15,702	20,916

United Kingdom.—*Production, imports, exports, and consumption of crude aluminum, 1925–1929, in metric tons*

	1925	1926	1927	1928	1929
Production	9,700	8,000	9,700	9,700	8,000
Imports	10,223	12,179	15,398	13,583	22,647
	19,923	20,179	25,098	23,283	30,647
Exports	3,777	4,175	4,985	5,983	5,728
Consumption	16,100	16,000	20,100	17,300	25,000

British imports of aluminum in 1929 came from: Norway, 64 per cent; Canada, 20 per cent; Germany, 5 per cent; Switzerland, 4 per cent; United States, 3 per cent; Belgium, 2 per cent; and other countries, 2 per cent. Bauxite was obtained chiefly from France.

The principal companies operating alumina plants include:

1. British Aluminium Co. (Ltd.), at Larne Harbor, County Antrim, Ireland, and at Burnt Island, Fifeshire, Scotland.
2. International Aluminium Co. (Ltd.)(owned by Aluminium Co. (Ltd.)), at Hebburn, Newcastle-on-Tyne, England.

The main aluminum-reduction plants are as follows:

1. British Aluminium Co. (Ltd.), at Kinlochleven, Argyllshire, Scotland, and at Foyers, Invernessshire, Scotland.
2. North British Aluminium Co. (Ltd.)(owned by British Aluminium Co. (Ltd.)), at Fort William, Invernessshire, Scotland.
3. Aluminium Corporation (Ltd.), at Dolgarrog Sidings, near Llanrwst, North Wales.

In addition, the Aluminum Co. of America controls the Northern Aluminium Co., the Aluminium Casting Co. (Ltd.), and the Aluminium Rolling Works, at Birmingham.

YUGOSLAVIA

Yugoslavia produced 103,366 metric tons of bauxite in 1929, compared with 49,264 tons in 1928, 100,327 tons in 1927, 131,828 tons in 1926, and 79,032 tons in 1925. About 70,000 tons was exported to Germany in 1929.

The chief deposits occur in Dalmatia; the bauxites average 57 per cent Al_2O_3, 1 to 2 per cent SiO_2, 24 per cent Fe_2O_3, 3.8 to 4.2 per cent TiO_2, and 12 per cent combined water. Lesser deposits are found in Carniola, Croatia, Herzegovina, Slovenia, and Montenegro. Reserves are said to total 50,000,000 tons, averaging 53 to 56 per cent Al_2O_3.[33]

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[33] Davis, L. A., Bauxite Resources of Yugoslavia: Commerce Repts., Aug. 20, 1928, p. 490.

French, German, and American companies have important holdings in Yugoslavia.

Phosphates Tunisiens, a French company, plans to increase the size of the Gubavica hydroelectric plant from 30,000 to 100,000 horsepower[34] and to erect a cement and aluminum works in the neighborhood of the deposits.

A German company[35] is erecting a new aluminum works at Mostar, in Herzegovina.

ASIA

INDIA

India produced 9,189 metric tons of bauxite in 1929, compared with 14,902 tons in 1928 (11,346 tons from the Kaira district in Bombay and 3,556 tons from the Jubbulpore district in the Central Provinces), 4,379 tons in 1927, 5,036 tons in 1926, and 10,232 tons in 1925.

Aluminous (bauxite) deposits of consequence occur on the Baihir plateau in the Balagat district and in the vicinity of Katni in the Jubbulpore district, both in the Central Provinces. Good bauxite has been found in the laterite plateau in the western part of Chota Nagpur and in Sarguja (Bihar and Orissa) in the Satara district (Bombay), and in various parts of Madras Presidency. The Balagat bauxites have the following range of composition:

	Per cent
Alumina[36]	51. 62 to 58. 83
Silica	. 05 to 2. 65
Ferric oxide	2. 70 to 10. 58
Titanium dioxide	6. 22 to 13. 76
Combined water	22. 76 to 30. 76
Moisture	. 40 to 1. 14

JAPAN

Japan imports aluminum from other countries, chiefly from the United States; imports amounted to 11,894 metric tons in 1929, compared with 9,168 tons in 1928, 5,980 tons in 1927, 7,547 tons in 1926, and 4,725 tons in 1925. Japan also imported from 500 to 1,000 tons of cryolite in 1929, but no report on production of aluminum has been seen by the writer.

The principal consumer of aluminum is the Sumitomo Electric Wire Works; this company uses American aluminum. A recent report[37] indicates that some of the Japanese aluminum-consuming companies have entered into an agreement to purchase their entire supply from and sell their products to British, French, German, and Swiss manufacturers. These companies include the Mitsubishi, Nichizu, and Furukawa trading and manufacturing concerns.

AFRICA

FRENCH MOROCCO

Bauxite found in French Morocco has been described as follows:[38]

> Considerable interest is shown by the German aluminum industry in newly discovered bauxite deposits in French Morocco. As reported from Marrakesch,

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[34] American Metal Market, vol. 36, No. 78, Apr. 23, 1929, p. 4.

[35] Mining Journal, London, vol. 171, No. 4963, Oct. 4, 1930, p. 783.

[36] Content after calcination is 71. 2 to 80. 8 per cent Al_2O_3.

[37] Metal Bulletin, No. 1475, Mar. 7, 1930, p. 10.

[38] Claiborne, H. C., Developments in the German Aluminum Industry: Commerce Reports, Mar. 26, 1928, p. 817.

the deposits are situated in the Atlas Mountains, and it is estimated from top layers alone 20,000,000 tons of bauxite can be obtained. The mineral has a large alumina content, estimated at 70 per cent, and numerous water falls in the vicinity can furnish water power for the mining operations.

GOLD COAST

Bauxite, or aluminum hydrate, with certain impurities is found over portions of Gold Coast Colony and Ashanti, as a cap from a few feet to more than 50 feet in thickness on the summits of several mountains. The ores are of fairly high grade. The most important deposits are those of the Mount Ejuanema Kwahu district, estimated to have about 4,000,000 tons, and the Sefwi Bekwai district, having about 33,300,000 tons.[39] The Ejuanema deposit is 1½ miles in a direct line from Nkawkaw railway station, which is 111 miles from the port of Accra or 249 miles from the port of Sekondi, via Kumasi. The Sefwi Bekwai deposits are about 55 miles northwest of Dunkwa, a station on the Sekondi-Kumasi Railway 100 miles from Sekondi. Average analyses of 198 specimens from Mount Ejuanema and of 55 specimens from Mount Supirri, Sefwi, are reported as follows:

	Mount Ejuanema	Mount Supirri
SiO_2	0.87	1.88
Al_2O_3	60.66	55.77
Fe_2O_3	9.27	10.30
TiO_2	1.94	1.12
H_2O	26.80	30.69

During 1928 a large deposit of bauxite was discovered[40] 4 to 5 miles west of Kumasi, 18 miles northeast of Bibiani, at the end of a proposed Western Province Railway in the Yenahin district; the deposit is alleged to contain 180,000,000 tons of good ore. Bauxite deposits have been located in the Pusu Pusu River, Kibi district, in Akim, and small deposits at Atiwa Range, Sajumase.

Although the economic value of these Gold Coast deposits has not been demonstrated and the quantity of bauxite reported for the Yenahin district seems almost fantastic, it seems probable that the Gold Coast may be counted upon to provide reserves of substantial character for the future.

OCEANIA

AUSTRALIA

Bauxite deposits have been found 60 miles southwest of Gladstone, at Crows Nest near Toowoomba, and at Cooranga station in the Gaynah district, Queensland, and numerous high-iron bauxite deposits are known in New South Wales. Aluminous clays, alunite, and bauxitic clays have been found in other sections of Australia. Production has been small and has come chiefly from Victoria which produced 555 metric tons of bauxite in 1929, compared with 196 tons in 1928 and 936 tons in 1927.

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[39] American Metal Market, Large Bauxite Deposits of Gold Coast: Dec. 9, 1927.
[40] Mining Journal, London, vol. 164, No. 4882, Mar. 16, 1929, p. 200.

LEAD AND ZINC PIGMENTS AND SALTS [1]

By Elmer W. Pehrson [2]

SUMMARY

Lead pigments accounted for 55.6 per cent and zinc pigments 44.4 per cent of the total value of the lead and zinc pigments sold by domestic producers in 1929, which amounted to approximately $98,045,000, an increase of 2 per cent over 1928. Both the lead and the zinc pigments sold increased 2 per cent in total value in 1929.

The quantity of lead pigments sold by producers in 1929 amounted to 295,460 short tons, a decrease of nearly 1 per cent. Sales of litharge, red lead, and orange mineral increased in 1929, whereas sales of white lead in oil and white sublimed lead decreased. Sales of white lead in oil were the lowest since 1918 and were equivalent to only 68 per cent of the 1922 sales. Sales of dry white lead and blue sublimed lead were practically unchanged in 1929.

The quantity of zinc pigments sold by producers in 1929 amounted to 394,075 short tons, an increase of 2 per cent over 1928. Sales of lithopone increased by 6,000 tons, or 3 per cent, and those of leaded zinc oxide increased by 3,000 tons, or 12 per cent; sales of zinc oxide decreased slightly.

Sales of zinc chloride increased 2 per cent over 1928.

Quoted prices of lead pigments in 1929 followed closely the fluctuations in pig-lead quotations; the average price received per ton of lead pigments sold by producers, as reported to the Bureau of Mines, increased only 3 per cent, whereas the average quoted price for pig lead increased 8 per cent. Quotations on zinc pigments were unchanged throughout the year at levels established in 1927; the average price received by producers per ton of zinc pigments sold, as reported to the Bureau of Mines, decreased 0.3 per cent, whereas the average quoted price for slab zinc increased 8 per cent.

Imports of lead pigments in 1929 were negligible. Exports of lead pigments increased 3 per cent in quantity and 8 per cent in value and amounted to 3 per cent of the total quantity sold by domestic producers. The total quantity of white lead and sublimed lead exported decreased 9 per cent, whereas that of the red oxides increased 39 per cent.

Imports of zinc pigments in 1929 decreased 12 per cent in quantity and 5 per cent in value and were equivalent in quantity to less than 3 per cent of the sales by domestic producers. Imports of lithopone and zinc oxide decreased, whereas imports of zinc sulphide nearly doubled. Exports of zinc pigments in 1929 increased 22 per cent in quantity and 26 per cent in value and amounted in quantity to nearly 6 per cent of the total domestic output.

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[1] Work on manuscript completed December, 1930.

[2] The statistics in this report were prepared (unless otherwise indicated) by H. M. Meyer, and the data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

An outstanding feature of the lead and zinc pigment industry during the last few years has been the severe competition between white lead and other pigments for the paint trade. The effect of this is indicated roughly in the comparative sales of the pigments concerned. Sales of white lead in oil decreased from 153,000 tons in 1922 to 105,000 tons in 1929. During the same period the combined sales of zinc oxide and lithopone increased from 212,000 to 367,000 tons. As three-fourths of the lithopone and about one-third of the zinc oxide produced in the United States are used in the manufacture of paints, these figures indicate the marked degree to which the zinc pigments have invaded the paint industry at the expense of white lead.

The rapid expansion in the use of nitrocellulose paints in recent years has not altered materially the quantity of pigments consumed. The average nitrocellulose paint contains considerably less pigment per gallon than oil paints, but a heavy pigment priming coat and more finishing coats are used to offset the low pigment content. White lead is seldom used in these paints owing to its chemical instability in contact with nitrocellulose products. As it is desirable to have a low pigment content in nitrocellulose paints there has been an increased use of high hiding-power pigments such as high-strength lithopone and titanium pigments.

PRODUCTION

In this chapter the pigments and salts sold are considered as representing the production, no account being taken of the stocks on hand at the beginning and end of the year. The amounts used by producers at their own plants are included under sales. The total value of the lead and zinc pigments sold by domestic producers was approximately $98,045,000 in 1929 as compared with $96,136,000 in 1928, the increase being shared about equally by the lead and the zinc pigments. The quantity of lead pigments was slightly less in 1929 than in 1928, but the average value per ton was 3 per cent more; the average quoted price for pig lead was 8 per cent higher than in 1928. There was a slight increase in the quantity of zinc pigments in 1929, but the average value per ton was 0.3 per cent less than in 1928; the average quoted price for slab zinc increased 8 per cent over 1928.

The following tables show the production of lead and zinc pigments and zinc salts as reported to the Bureau of Mines.

Lead pigments sold by domestic manufacturers in the United States, 1920–1929, in short tons

Year	White lead		Basic lead sulphate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In oil	White	Blue			
1920	33,678	112,017	12,412	928	[1] 34,431	(1)	62,329
1921	26,738	143,545	11,568	463	21,805	381	41,909
1922	41,598	153,393	13,765	972	30,509	370	58,261
1923	37,786	125,087	11,949	800	38,037	646	75,107
1924	42,622	144,872	14,572	1,088	36,813	331	74,724
1925	43,426	120,479	14,996	1,090	41,669	840	86,546
1926	37,968	111,845	12,271	1,236	42,550	813	82,540
1927	38,669	119,026	13,482	1,061	39,073	709	81,655
1928	42,049	111,923	16,002	1,234	40,497	459	85,570
1929	42,159	104,872	15,580	1,234	43,021	678	87,916

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[1] Figures for red lead include orange mineral prior to 1921.

Lead pigments sold by domestic manufacturers in the United States, 1928 and 1929

	1928			1929		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Basic lead sulphate or sublimed lead:						
White	16,002	$2,211,470	$138	15,580	$2,274,917	$146
Blue	1,234	175,508	142	1,234	195,849	159
Red lead	40,497	6,816,876	168	43,021	7,586,543	176
Orange mineral	459	112,521	245	678	165,039	243
Litharge	85,570	12,872,730	150	87,916	13,807,087	157
White lead:						
Dry	42,049	6,688,115	159	42,159	6,821,200	162
In oil	111,923	24,553,989	219	104,872	23,679,875	226

Zinc pigments and salts sold by domestic manufacturers in the United States, 1920–1929, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° Baumé)	Zinc sulphate
1920	99,444	30,460	89,373	[1] 68,945	[1] 3,072
1921	74,329	16,103	55,016	59,457	3,295
1922	128,465	19,613	83,360	41,627	5,078
1923	126,987	23,504	98,199	42,431	5,375
1924	131,470	26,729	109,469	51,054	4,674
1925	151,354	31,750	145,019	45,619	5,332
1926	146,923	23,859	159,931	45,724	(2)
1927	151,246	26,064	176,994	36,096	(2)
1928	160,904	24,223	200,468	38,837	(2)
1929	160,611	27,149	206,315	39,615	(3)

[1] Figures cover production, not sales.
[2] Figures published in earlier reports of this series have been revised, and the Bureau of Mines is not at liberty to publish the revised figures.
[3] Bureau of Mines not at liberty to publish figures.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1928 and 1929

	1928			1929		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide [1]	160,904	$20,685,442	$129	160,611	$20,516,246	$128
Leaded zinc oxide [1]	24,223	2,945,323	122	27,149	3,224,544	119
Lithopone	200,468	19,073,914	95	206,315	19,773,864	96
Zinc chloride, 50° Baumé	38,837	1,706,222	44	39,615	1,351,925	34
Zinc sulphate	(2)	(2)	(2)	(3)	(3)	(3)

[1] Zinc oxide containing 5 per cent or more of lead is classed as leaded zinc oxide.
[2] Figures published in the report of this series for 1928 have been revised, and the Bureau of Mines is not at liberty to publish the revised figures.
[3] Bureau of Mines not at liberty to publish figures.

Statistics for lead arsenate, lead acetate, zinc stearate, and other lead and zinc salts and compounds are collected biennially by the Bureau of the Census for odd years. The following tables show the production (exclusive of pigments, zinc chloride, and zinc sulphate) during the past few years, as compiled by that bureau.

Lead acetate, lead arsenate, and other lead salts (exclusive of lead pigments) produced in the United States, 1919, 1921, 1923, 1925, 1927, and 1929

Year	Lead acetate			Lead arsenate		Other salts
	Total production	Produced for sale				
	Short tons	Short tons	Value	Produced for sale (short tons)	Value	Value
1919	2,566	2,092	$552,435	5,733	$2,090,341	$335,906
1921	1,408	372	90,305	4,615	1,629,446	120,327
1923	2,753	616	160,133	5,378	2,229,431	388,868
1925	3,432	1,251	359,686	5,969	1,777,552	192,995
1927	(1)	1,508	395,122	[2] 10,764	[2] 3,190,257	254,809
1929	(1)	1,042	255,753	[2] 14,952	[2] 3,304,351	186,736

[1] Not given.

[2] The statistics for 1927 and 1929 are not comparable with those for preceding years as the figures prior to 1927 do not include data for the production reported by establishments engaged primarily in the manufacture of patent and proprietary medicines and compounds.

Zinc stearate and other salts and compounds of zinc (exclusive of zinc pigments, zinc chloride, and zinc sulphate) produced in the United States, 1923, 1925, 1927, and 1929

Year	Zinc stearate		Other salts and compounds, value
	Short tons	Value	
1923	227	$107,319	$410,913
1925	393	169,051	420,944
1927	391	164,927	376,666
1929	727	320,203	(1)

[1] Not given.

SOURCE

The following table gives the quantity and source of the lead and zinc contained in the pigments and salts produced in the United States in 1928 and 1929. It shows that in 1929, 95 per cent of the lead in lead pigments was derived from pig lead, 4 per cent from ore, and 1 per cent from secondary material. For zinc pigments and salts, the proportions were 68 per cent from ore, 19 per cent from metal, and 13 per cent from secondary material. The zinc in zinc salts is derived largely from secondary material.

Metal content of lead pigments and zinc pigments and salts produced by domestic manufacturers, 1928 and 1929, by sources, in short tons

Source	1928		1929	
	Lead in pigments [1]	Zinc in pigments and salts	Lead in pigments [1]	Zinc in pigments and salts
Domestic ore	10,465	124,090	9,429	137,892
Metal	242,914	37,588	248,657	39,620
Secondary material [2]	654	25,353	2,427	26,040
	254,033	187,031	260,513	203,552

[1] Includes also lead recovered in zinc oxide and leaded zinc oxide. The metal content of lead acetate and lead arsenate is not available, as no canvass of their production is made by the Bureau of Mines. Moreover, these salts are derived from pig lead, and their metal content has already been taken into statistical account in the figures covering lead production.

[2] Zinc ashes, skimmings, drosses, and old metal.

PREPARATION AND USES

WHITE LEAD

White lead is the basic carbonate of lead and is the oldest and most important of the white pigments used in oil paint. The properties of white lead that contribute to its usefulness in paint are its very great hiding power and the facility with which white-lead paint can be worked with a brush. Owing to its relatively high first cost and the fact that white-lead paints are blackened by compounds containing sulphur, the use of less-expensive zinc oxide and lithopone as paint pigments has increased during recent years and has seriously retarded expansion of the white-lead industry.

The largest part of the white lead manufactured in the United States is produced by the "stack" or old Dutch process, wherein perforated disks of high-grade metallic lead, called buckles, about 6 inches in diameter, are placed in small clay pots, each of which has a well in the bottom containing dilute acetic acid. These pots are arranged in tiers within a large room. Each tier is covered with boards and a layer of spent tanbark. The lead is corroded to the basic carbonate by the action of acetic acid vapor and CO_2. The CO_2 and the heat necessary to vaporize the acetic acid are produced by the fermentation of the tanbark. The process requires three to four months for completion. The corroded lead buckles are washed, crushed, screened, and ground in water, and the pulp is either dried to form dry white lead or ground with oil without drying to form the oil pigment. In the United States about three-fourths of the product is ground in oil.

Some white lead is also made by the Carter process and the electrolytic process. In the former metallic lead is finely divided by a jet of steam and is then treated with dilute acetic acid and carbon dioxide in slowly rotating wooden cylinders. The process is completed in about 12 days.

In the electrolytic process a lead anode and an iron cathode are used, each of which has an independent continuous circulation of electrolyte kept separate by a porous diaphragm. The electrolytes are solutions of sodium acetate containing sodium carbonate. The anolyte contains the exact amount of carbonate necessary to precipitate the basic lead carbonate, whereas the catholyte contains a relatively large amount of carbonate. During electrolysis the lead dissolves at the anode surface and is immediately precipitated as the basic carbonate in suspension in the anolyte. At the same time CO_3 is generated at the cathode, passes through the diaphragm, and replaces the CO_3 precipitated with the lead, thus maintaining the anolyte at a constant concentration. The catholyte passes through a carbon dioxide absorption tower where it is restored to its original strength. The basic lead carbonate is filtered from the anolyte, washed, dried, pulverized, and barreled.

During 1929 it was announced[3] that a new process had been developed for producing white lead and other lead pigments directly from galena ore, in which the ore is first treated with nitric acid. The resultant solution is then purified by a secret process which yields an extremely pure solution of lead from which pigments of high purity can be produced. White lead is precipitated from this solution by the addition of sodium carbonate (soda ash or sal soda), chrome yellow by the addition of sodium bichromate, and basic lead sulphate by the addition of sodium sulphate. The precipitates are very finely divided and are collected in filter presses, washed, dried, and ground. The process involves the regeneration of nitric acid and the recovery of by-products, including zinc oxide, silica, and elemental sulphur. The General Reduction & Chemical Co. was contemplating the erection of three plants, each to cost $1,500,000.

The principal use of white lead is in the manufacture of paint. It is the only important white pigment that is used unmixed with other pigments in oil paints; it is also used in varying proportions in many mixed pigments. Dry white lead is used in paints, as a constituent of the glaze used in the finer grades of pottery, and to some extent in the manufacture of rubber.

The following table shows the sales of white lead (dry and in oil) to various industries in 1929, as reported to the Bureau of Mines by the producers.

Distribution of white lead (dry and in oil) sales in 1929, by industries

Industry	Short tons	Per cent of total
Paint	136,526	92.8
Ceramics	4,246	2.9
Other	6,259	4.3
	147,031	100.0

The United States produces an exportable surplus of about 6,000 tons of white lead annually, most of which is manufactured in bond from foreign lead.

BASIC LEAD SULPHATE

Basic lead sulphate is also known as sublimed lead and is marketed in two forms, "white" and "blue." The white variety is usually made by vaporizing powdered galena at a high temperature in the presence of air, which oxidizes it to the basic sulphate. The resultant fume is collected in bags, and owing to the zinc content of the ore used it usually contains about 5 per cent of zinc oxide. This product is usually not as white as basic carbonate white lead, but has a more stable color in the presence of sulphur gases. White sublimed lead is also made directly from pig lead. The molten metal is blown through an atomizing nozzle into a heated furnace, and at the same time free oxygen and sulphur dioxide are introduced. The lead is vaporized, oxidized, and converted into basic lead sulphate or lead sulphate in quantity proportionate to the oxygen and sulphur dioxide introduced into the furnace. The resultant fume is collected in settling chambers. It is claimed that this product is the whitest of the lead pigments and that it has a promising future in the manufacture of storage batteries, where it is used with lead oxides to produce extraordinarily active battery plates. In 1929 the development of a process for making basic lead sulphate directly from ore, using nitric acid and sodium sulphate, was reported (see discussion under white lead on p. 512). White sublimed lead is used chiefly in the manufacture of prepared paints and mixed pigments. Smaller amounts are used in the manufacture of storage batteries and rubber.

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[3] Oil, Paint and Drug Reporter, vol. 125, June 3, 1929, p. 29.

The blue variety is generally a by-product of the smelting of pig lead and is collected from the fumes leaving the smelting furnaces. Its color is due to small amounts of carbon and lead sulphide. Paints made from blue lead are especially useful as protective coatings on metallic surfaces. Some blue lead is also used in the manufacture of rubber.

The following table shows the sales of basic lead sulphate to various industries in 1929, as reported to the Bureau of Mines by the producers.

Distribution of basic lead sulphate sales in 1929, by industries

Industry	Short tons	Per cent of total
Paints	13, 435	79. 9
Storage batteries	2, 327	13. 8
Rubber	655	3. 9
Other	397	2. 4
	16, 814	100. 0

LITHARGE

Litharge is the monoxide of lead and is produced by the oxidation of molten lead at a moderate temperature in a reverberatory furnace. The oxide forms on the surface of the molten metal and is raked off into iron pots. •The texture and color of the litharge, which affect its use in the various industries, are controlled by the temperature of the furnace and the method of cooling. The chief use of litharge is in the manufacture of storage-battery plates. The negative plates are usually made of straight litharge, whereas the positive plates are a mixture of red lead and litharge. The next largest use of litharge is in the oil-refining industry, where it is used to remove objectionable sulphur compounds from gasoline. Litharge acts as a toughener and cure accelerator in the manufacture of mechanical rubber goods and rubber clothing. It is also used in the manufacture of lead chromate color pigment, insecticides, pottery, enamel ware, and glass, and as a drier in the manufacture of varnish and linoleum.

The following table shows the sales of litharge to various industries in 1929, as reported to the Bureau of Mines by the producers.

Distribution of litharge sales in 1929, by industries

Industry	Short tons	Per cent of total	Industry	Short tons	Per cent of total
Storage batteries	37,160	42.2	Varnish	3,124	3.6
Oil refining	13,615	15.5	Linoleum	322	.4
Ceramics	8,663	9.8	Other	10,269	11.7
Chrome pigments	8,112	9.2			
Rubber	6,651	7.6		87,916	100.0

RED LEAD

Red lead is the tetroxide of lead and is made by heating powdered litharge at a moderate temperature in a "coloring oven." The marketed product varies in composition, averaging about 85 per cent pure red lead and 15 per cent litharge; the latter is unchanged in the process of manufacture. The principal use of red lead is in the manufacture of storage batteries where, mixed with litharge, it usually forms the positive plate of the battery. It is an important pigment in paints used as a protective coating on metal surfaces and accounts for the familiar orange color seen on practically all steel construction. During 1929 the American Gas Association and the Bureau of Standards began tests for protective coatings on underground pipe lines. The tests were to include the use of a baked red-lead priming coat under asphaltic or bituminous protective coatings. Red lead is the most important of the lead compounds used in the production of flint and optical glass. It is also used in potter's glaze and in enamel ware and as a drier in the manufacture of varnish.

The following table shows the sales of red lead to various industries in 1929, as reported to the Bureau of Mines by the producers.

Distribution of red lead sales in 1929, by industries

Industry	Short tons	Per cent of total
Storage batteries	25,689	59.7
Paints	11,855	27.6
Ceramics	903	2.1
Other	4,574	10.6
	43,021	100.0

ORANGE MINERAL

Orange mineral is a form of red lead; it has the same chemical composition but differs in physical properties and has a lower specific gravity and lighter color. It is usually made by roasting white lead by a process that requires great care and skill. Consequently, the price is higher than that for any of the other lead pigments. Orange mineral is used chiefly in the manufacture of an artificial vermilion color pigment known as eosin lake; it is also used in the production of printer's inks and enamels.

The following table shows the sales of orange mineral to various industries in 1929, as reported to the Bureau of Mines by the producers.

Distribution of orange mineral sales in 1929, by industries

Industry	Short tons	Per cent of total
Color pigments	487	71.8
Ink manufacture	151	22.3
Other	40	5.9
	678	100.0

ZINC OXIDE

Zinc oxide, the monoxide of zinc, is made in the United States by two processes—the French and the American. In the former, metallic zinc is heated in a current of air, and the resultant oxide fume is collected in long chambers. The product is graded according to its fineness and is labeled "white seal," "green seal," or "red seal." The white-seal variety is the finest and whitest grade. Its specific gravity is much lower than those of the coarser grades. It is used chiefly in high-grade enamel paints. Green seal and red seal are the intermediate and heavy grades, respectively.

American process zinc oxide is made by heating a mixture of zinc ore and anthracite to produce a metallic zinc vapor, which in turn is treated with air to form the oxide. The oxide fume is collected in bag houses. As lead is usually present in the ore the resultant oxide contains some lead compounds. It is usually not quite as white as French oxide but in other respects is very similar. The American process of making zinc oxide predominates in the United States.

Zinc oxide has been used as a paint pigment to a moderate extent for several centuries, but the increase in production in the United States during the twentieth century has been due mainly to the growth of the rubber industry. In an estimate made in January, 1926,[4] the use of zinc oxide in the various industries was given as follows:

	Per cent
Rubber	53
Paints and enamels	33
Oilcloth and linoleum	5
Exports	4
Ceramics	3
Miscellaneous	2
	100

Zinc oxide is used in the manufacture of rubber because of the beneficial properties it imparts to the rubber. It increases the tensile strength and the resistance to abrasion and tear and improves the aging qualities by counteracting the tendency of rubber goods to deteriorate under action of light and heat. All of these properties are essential in making automobile tires, tubes, and accessories, which represent about 75 per cent of the entire rubber industry.

Zinc oxide is seldom used alone as a paint pigment, as it dries to a hard, smooth surface which on aging tends to crack and peel off, leaving an unsatisfactory surface for repainting. It has a more stable color and costs less than white lead, has excellent white color and covering properties, and is durable. These many advantages make zinc oxide a useful constituent of mixed paints, in which it finds a large usage. It is generally mixed with lithopone, white lead, and inert pigments.

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[4] Chemical and Metallurgical Engineering, vol. 33, January, 1926, p. 55.

Zinc oxide is also used in the manufacture of oilcloth and linoleum, pottery glazes and glass, celluloid, druggists' supplies, printer's inks, and leather finishes, and for many other purposes.

The use of zinc oxide as a lubricant was reported[5] in 1929. A mixture of zinc oxide and oil in equal parts is said to prevent corrosion of bearings and to improve the bearing surface by depositing thereon a thin film of zinc.

Exports of zinc oxide in 1929 amounted to 11 per cent of the total production.

LEADED ZINC OXIDE

Leaded zinc oxide is made by a method similar to the American process of making zinc oxide. The ore used contains lead in varying proportions, and the finished product may contain from 5 to 35 per cent of basic lead sulphate. The properties of this pigment are similar to those of zinc oxide and basic lead sulphate. It has fair hiding power but is not so white as American process zinc oxide. Leaded zinc oxide is used chiefly in the manufacture of paint.

LITHOPONE

Lithopone is the newest of the important white pigments, and its introduction into the United States dates back to the close of the nineteenth century. It contains about 70 per cent of barium sulphate and about 30 per cent of zinc sulphide. The latter, a powerful pigment, is responsible for the useful pigment qualities of lithopone. The process of manufacture consists in mixing proper proportions of solutions of barium sulphide and zinc sulphate. The resultant precipitate is heated to a red heat and plunged into cold water, after which it is ground, dried, and powdered.

The use of high-strength lithopone, containing above 30 per cent of zinc sulphide, has been increasing in recent years. This product can be made directly or by mixing zinc sulphide with ordinary lithopone. The increase in imports of zinc sulphide from less than 4 short tons in 1926 to more than 315 tons in 1929 has probably been due to the increased manufacture of high-strength lithopone. This pigment is said to possess very high hiding power and nonsettling properties which make it particularly suitable for the manufacture of shelf goods.

The use of lithopone in the United States has increased rapidly and has spread to many industries. Its chief use is in paint manufacture, in which it is favored on acount of its low cost and many good qualities. Formerly the use of lithopone was confined to interior paint, as the pigment would discolor in sunlight. In recent years, however, the refining process has been changed, and it is claimed that lithopone with a stable color suitable for exterior paints is now being produced. It is generally mixed with other pigments, notably zinc oxide.

A large quantity of lithopone is used in the manufacture of oilcloth and linoleum, artificial leather finishes, window shades, and printer's inks.

Imports of lithopone into the United States in 1929 amounted to 8,400 short tons, and exports amounted to 4,600 tons.

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[5] Chemistry and Industry, vol. 48, Nov. 22, 1929, p. 1136.

The following table shows the sales of lithopone to various industries in 1928 and 1929, as reported to the Bureau of Mines by the producers.

Distribution of lithopone sales, 1928 and 1929, by industries

Industry	1928		1929	
	Short tons	Per cent of total	Short tons	Per cent of total
Paints, varnish, and lacquers	149,122	74.4	150,804	73.1
Floor coverings and textiles	35,416	17.7	37,506	18.2
Rubber	6,898	3.4	7,176	3.5
Other	9,032	4.5	10,829	5.2
	200,468	100.0	206,315	100.0

ZINC SALTS

Zinc sulphate, sometimes known as white vitriol, is usually made by treating secondary zinc material with dilute sulphuric acid, which upon evaporation yields the white crystalline salt. One of the principal uses of zinc sulphate is as a depressing reagent in the flotation of lead-zinc ores. It has recently been used as a weed killer in the tree nurseries of the United States Forestry Service. It is also used in the solutions of electro-galvanizing cells, to some extent in calico printing and in dyeing, as a drier for linseed oil, as a disinfectant and astringent, and as a sizing on cement prior to painting. In addition to these uses, several thousand tons is used yearly in the manufacture of lithopone; as this sulphate represents an intermediate product it is not separately recorded by the Bureau of Mines.

Zinc chloride may be prepared by treating zinc directly with chlorine or with hydrochloric acid, the latter being more generally used. Practically all zinc chloride produced in the United States is made from scrap metal or secondary materials, such as drosses, ashes, skimmings, and galvanizer's scrap. Owing to its hygroscopic properties it is usually marketed in solution, although the fused salt may be obtained in air-tight containers. Zinc chloride is used chiefly as a preservative of timber, but it is also used as a germicide and disinfectant, in the refining of petroleum, in the textile industry, in the manufacture of hard fiber, for medical purposes, and in dentistry.

PRODUCERS AND PLANTS

The following companies reported having sold or used lead and zinc pigments and zinc salts of their own production in 1929.

White lead:

Anaconda Lead Products Co. (electrolytic process)	East Chicago, Ind.
Carter White Lead Co	West Pullman, Chicago, Ill.
Eagle-Picher Lead Co	East St. Louis, Ill.
Do	Cincinnati, Ohio.
Euston Lead Co	Scranton, Pa.
W. P. Fuller & Co	South San Francisco, Calif.
John T. Lewis & Bros. Co	Philadelphia, Pa.
National Lead Co. of California	Melrose, Calif.
National Lead Co	Chicago, Ill.
Do	St. Louis, Mo.
Do	Perth Amboy, N. J.

White lead—Continued.	
National Lead Co	Brooklyn, N. Y.
Do	Port Richmond, N. Y.
Do	Cincinnati, Ohio.
National Lead & Oil Co. of Pennsylvania	New Kensington, Pa.
Sherwin-Williams Co	Chicago, Ill.
Wetherill & Bro	Philadelphia, Pa.
Basic lead sulphate, or sublimed lead:	
Eagle-Picher Lead Co	Galena, Kans.
Do	Joplin, Mo.
St. Louis Smelting & Refining Works of National Lead Co	Collinsville, Ill.
Red lead, orange mineral, and litharge:	
Eagle-Picher Lead Co	East St. Louis, Ill.
Do	Joplin, Mo.
Do	Newark, N. J.
Do	Cincinnati, Ohio.
Evans-Wallower Lead Co	Charleston, W. Va.
Franklin Lead Oxide Co	Franklin, Pa.
W. P. Fuller & Co	South San Francisco, Calif.
Grasselli Chemical Co	East Chicago, Ind.
Do	Newark, N. J.
John T. Lewis & Bros. Co	Philadelphia, Pa.
Metals Refining Co	Hammond, Ind.
National Lead Co. of California	Melrose, Calif.
National Lead Co	Chicago, Ill.
Do	St. Louis, Mo.
Do	Brooklyn, N. Y.
National Lead & Oil Co. of Pennsylvania	New Kensington, Pa.
Sherwin-Williams Co	Chicago, Ill.
United Color & Pigment Co	Newark, N. J.
Wetherill & Bro	Philadelphia, Pa.
Zinc oxide and leaded zinc oxide:	
American Zinc Co. of Illinois	Hillsboro, Ill.
American Zinc Oxide Co	Columbus, Ohio.
Eagle-Picher Lead Co	Hillsboro, Ill.
Empire Zinc Co	Canon City, Colo.
Grasselli Chemical Co	East Chicago, Ind.
International Lead Refining Co. (French process)	East Chicago, Ind.
Do	Akron, Ohio.
Mineral Point Zinc Co	Mineral Point, Wis.
New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.
Do. (French process)	Freemansburg, Pa.
Ozark Smelting & Mining Co	Coffeyville, Kans.
River Smelting & Refining Co	Florence, Colo.
Lithopone:	
Chemical & Pigment Co. (Inc.)	Oakland, Calif.
Do	Collinsville, Ill.
Do	St. Helena, Md.
Eagle-Picher Lead Co	Argo, Ill.
Grasselli Chemical Co	Grasselli, N. J.
Do	Newark, N. J.
Do	Philadelphia, Pa.
Krebs Pigment & Chemical Co	Newport, Del.
Mineral Point Zinc Co	Depue, Ill.
New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.
Sherwin-Williams Co	Chicago, Ill.
United Color & Pigment Co	Newark, N. J.
Zinc salts:	
American Smelting & Refining Co	Selby, Calif.
Do	Durango, Colo.
Do	Omaha, Nebr.
Do	Perth Amboy, N. J.
Arkansas Preservative Co	North Little Rock, Ark.
Charles Cooper & Co	Newark, N. J.
General Chemical Co	Chicago, Ill.

Zinc salts—Continued.	
Grasselli Chemical Co	East Chicago, Ind.
Do	Cleveland, Ohio.
Do	Weirton, W. Va.
Charles Lennig & Co. (Inc.)	Philadelphia, Pa.
Merrimac Chemical Co	Everett, Mass.
Monsanto Chemical Works	Monsanto, Ill.
Ozark Smelting & Mining Co	Coffeyville, Kans.

TARIFF

The tariff act of 1930 became effective June 18, 1930. The only changes in the schedules on lead and zinc pigments and salts were an increase from 1½ cents to 3 cents per pound on zinc sulphide, and an increase from 1¾ cents per pound to 1¾ cents per pound plus 15 per cent ad valorem on lithopone containing by weight 30 per cent or more of zinc sulphide. The rates on lead and zinc pigments and salts provided in the 1930 act are shown in the following statement.

Import duties on lead and zinc pigments and salts under the tariff act of 1930

Paragraph	Item	Import duty
72	Lead pigments:	
	Litharge	2½ cents per pound.
	Orange mineral	3 cents per pound.
	Red lead	2¾ cents per pound.
	White lead	2½ cents per pound.
	All pigments containing lead, dry or in pulp, or ground in or mixed with oil or water, not specially provided for	30 per cent ad valorem.
46	Lead chemicals:	
	Acetate, white	2½ cents per pound.
	Acetate, brown, gray, or yellow	2 cents per pound.
	Nitrate, arsenate, and resinate	3 cents per pound.
	All other lead compounds, n. s. p. f	30 per cent ad valorem.
77	Zinc pigments:	
	Zinc oxide and leaded zinc oxide containing not more than 25 per cent of lead—	
	Dry powder	1¾ cents per pound.
	Ground in or mixed with oil or water	2¼ cents per pound.
	Lithopone, and other combinations or mixtures of zinc sulphide and barium sulphate containing by weight—	
	Less than 30 per cent of zinc sulphide	1¾ cents per pound.
	30 per cent or more of zinc sulphide	1¾ cents per pound and 15 per cent ad valorem.
93	Zinc chemicals:	
	Zinc chloride	1 3/10 cents per pound.
	Zinc sulphate	¾ of 1 cent per pound.
	Zinc sulphide	3 cents per pound.

IMPORTS AND EXPORTS

LEAD PIGMENTS

Imports of lead pigments into the United States are relatively unimportant. Exports of the white lead pigments decreased 9 per cent in 1929 and amounted to 4 per cent of the total domestic output of white lead; United Kingdom took 57 per cent of the total in 1929, compared with 66 per cent in 1928. Combined exports of red lead, litharge, and orange mineral increased 39 per cent in 1929 and amounted to 2 per cent of the total domestic production of these three pigments.

Basic carbonate white lead, red lead, litharge, and orange mineral imported for consumption in the United States, 1920–1929

Year	Basic carbonate white lead		Red lead		Litharge		Orange mineral	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1920	159,977	$19,449	23,076	$1,789	21,002	$2,647	52,094	$5,352
1921	124,176	12,598	12,236	689	100	7	77,937	7,830
1922	222,465	21,335	1,405	94	1,770	162	111,419	9,729
1923	336,892	31,386	3,600	220	22,525	1,314	116,293	9,031
1924	141,156	13,478	1,874	155	1,838	193	99,341	8,047
1925	213,028	21,535	3,452	268	2,417	330	58,522	6,278
1926	297,567	31,690	9,591	817	122	13	58,104	5,143
1927	330,421	29,901	51,688	4,403	1,182	133	44,866	3,816
1928	166,236	15,889	24,675	1,510	2,100	153	62,409	5,227
1929	196,478	19,086	10,197	745	3,763	270	52,122	3,889

White lead and red lead exported from the United States, 1920–1929

Year	White lead [1]		Red lead [2]	
	Short tons	Value	Short tons	Value
1920	14,901	$3,195,101	1,532	$365,575
1921	5,161	993,130	548	115,500
1922	4,598	710,765	1,683	294,133
1923	[1] 5,172	836,261	[2] 1,840	372,828
1924	[1] 5,055	853,444	[2] 940	210,598
1925	[1] 6,832	1,293,168	802	183,591
1926	[1] 6,239	1,119,350	775	175,273
1927	[1] 6,047	947,226	[2] 1,429	271,376
1928	[1] 6,476	952,316	[2] 2,084	364,995
1929	[1] 5,908	921,509	[2] 2,890	503,243

[1] Exports of white lead and basic lead sulphate or sublimed lead not classified separately after 1922; the figures for 1923–1929 may include an unknown quantity of basic lead sulphate or sublimed lead.

[2] Exports of red lead and litharge not classified separately for 1923–1924 and 1927–1929; the figures for those years may include an unknown quantity of litharge; the figures for 1928 and 1929 include also an unknown quantity of orange mineral. Figures for other years are for red lead only.

White lead[1] exported from the United States, 1928 and 1929, by destinations

Destination	1928		1929	
	Short tons	Value	Short tons	Value
North America:				
Canada	58	$9,285	122	$19,807
Cuba	80	14,750	58	10,207
Mexico	149	32,640	127	28,776
Panama	284	57,022	568	117,561
Other	84	17,517	65	13,588
	655	131,214	940	189,939
South America:				
Brazil	45	7,043	12	2,231
Colombia	13	2,599	18	4,206
Uruguay	41	5,857	32	5,089
Venezuela	7	1,566	19	4,213
Other	402	59,370	415	68,061
	508	76,435	496	83,800

[1] Exports of white lead and basic lead sulphate or sublimed lead not classified separately after 1922; the figures may include an unknown quantity of basic lead sulphate or sublimed lead.

White lead exported from the United States, 1928 and 1929, by destinations—Contd.

Destination	1928		1929	
	Short tons	Value	Short tons	Value
Europe:				
Netherlands	657	$87, 528	532	$66, 715
United Kingdom	4, 274	586, 507	3, 382	482, 627
Other	64	10, 797	23	4, 656
	4, 995	684, 832	3, 937	553, 998
Asia:				
Philippine Islands	214	41, 294	228	47, 912
Other	99	17, 526	266	37, 948
	313	58, 820	494	85, 860
Africa	1	163	5	744
Oceania, including Australia	4	852	36	7, 168
	6, 476	952, 316	5, 908	921, 509

ZINC PIGMENTS AND SALTS

Imports of lithopone, the principal zinc pigment imported into the United States, decreased 15 per cent in 1929 and were equivalent to 4 per cent of the domestic output. Imports of zinc oxide decreased 5 per cent in 1929 and were equivalent to less than 1 per cent of the domestic production. There has been a large increase in the quantity of zinc sulphide imported into the United States during the last four years. This product is used principally in the manufacture of high-strength lithopone. Belgium supplied 60 per cent of the zinc oxide imported in 1929, Netherlands 82 per cent of the lithopone, and Germany 97 per cent of the zinc sulphide. The zinc oxide exported went chiefly to Canada (44 per cent) and the United Kingdom (36 per cent). Canada also took 87 per cent of the lithopone exported in 1929.

Zinc oxide, lithopone, zinc sulphide (white), zinc chloride, and zinc sulphate imported for consumption in the United States, 1920–1929

Year	Zinc oxide				Lithopone	
	Dry		In oil			
	Short tons	Value	Short tons	Value	Short tons	Value
1920	1, 431	$289, 890	14	$3, 596	1, 714	$263, 240
1921	1, 286	145, 071	57	17, 549	5, 247	432, 019
1922	2, 712	361, 599	42	8, 595	10, 763	885, 671
1923	1, 036	169, 415	89	21, 934	10, 440	776, 383
1924	1, 703	229, 629	110	25, 874	6, 830	543, 025
1925	1, 274	205, 582	132	31, 187	6, 330	478, 395
1926	1, 127	198, 897	94	23, 163	8, 686	661, 700
1927	1, 399	220, 427	77	18, 619	7, 979	656, 166
1928	1, 348	208, 557	107	25, 620	9, 885	808, 200
1929	1, 267	203, 080	110	27, 145	8, 409	725, 554

Zinc oxide, lithopone, zinc sulphide (white), zinc chloride, and zinc sulphate imported for consumption in the United States, 1920–1929—Contd.

Year	Zinc sulphide[1]		Zinc chloride		Zinc sulphate	
	Pounds[1]	Value	Short tons	Value	Short tons	Value
1920	45, 482	$15, 027	565	$76, 495	50	$3, 038
1921	93, 537	8, 330	2, 199	213, 995	17	820
1922	27, 159	8, 453	1, 374	87, 509	17	1, 064
1923	11, 844	5, 403	551	44, 164	20	3, 466
1924	9, 678	5, 727	319	28, 911	13	1, 265
1925	14, 604	5, 589	469	50, 712	17	1, 368
1926	7, 800	4, 125	568	51, 605	66	4, 590
1927	132, 223	22, 984	470	40, 069	205	9, 390
1928	338, 030	47, 235	563	47, 185	683	28, 866
1929	630, 565	84, 260	638	50, 324	909	32, 127

[1] Zinc sulphide is stated in pounds rather than tons because of its high value and smaller quantities.

Zinc oxide and lithopone exported from the United States, 1920–1929

Year	Zinc oxide		Lithopone	
	Short tons	Value	Short tons	Value
1920	11, 164	$2, 151, 544	(1)	(1)
1921	2, 511	426, 253	(1)	(1)
1922	3, 977	593, 128	1, 616	$169, 982
1923	5, 024	743, 577	1, 485	176, 624
1924	3, 927	605, 630	923	104, 783
1925	10, 855	1, 503, 561	1, 287	132, 771
1926	14, 661	1, 917, 420	1, 941	200, 412
1927	14, 494	1, 821, 786	2, 110	222, 585
1928	14, 799	1, 849, 889	3, 326	337, 565
1929	17, 638	2, 301, 643	4, 556	463, 235

[1] Not classified separately prior to 1922.

Zinc oxide exported from the United States, 1928 and 1929, by destinations

Destination	1928		1929	
	Short tons	Value	Short tons	Value
North America:				
Canada	6, 404	$882, 180	7, 702	$1, 062, 618
Cuba	135	20, 288	117	17, 508
Mexico	102	19, 112	73	13, 448
Panama	94	17, 291	87	15, 486
Other	30	5, 657	18	4, 483
	6, 765	944, 528	7, 997	1, 113, 543
South America:				
Brazil	8	1, 663	5	1, 129
Other	120	22, 011	64	13, 730
	128	23, 674	69	14, 859
Europe:				
France	(1)	93	452	50, 836
Italy	247	29, 270	69	11, 361
United Kingdom	4, 315	491, 658	6, 360	762, 010
Other	1, 859	186, 144	1, 144	125, 964
	6, 421	707, 165	8, 025	950, 171
Asia:				
Philippine Islands	93	11, 111	88	12, 264
Other	1, 130	129, 375	819	110, 415
	1, 223	140, 486	907	122, 679
Africa	4	724	3	594
Oceania, including Australia	258	33, 312	637	99, 797
	14, 799	1, 849, 889	17, 638	2, 301, 643

[1] Less than 1 ton.

PRICES AND VALUE

The total value and the average price received by producers from sales of lead and zinc pigments and salts are given on preceding pages of this chapter. The range of market quotations as reported by the Oil, Paint and Drug Reporter is shown in the following table.

Range of quotations on lead pigments and zinc pigments and salts at New York, 1927–1929, in cents a pound

Product	1927	1928	1929
Basic lead sulphate, or sublimed lead, dry, in casks	7.75– 9.00	7.75	7.75– 8.50
White lead, or basic lead carbonate:			
Dry, in casks	8.50– 9.75	8.25– 8.50	8.25– 9.00
In oil, carload lots	10.73–12.15	10.73	10.73–11.54
Litharge, American, commercial, powdered, casks	8.75–10.75	8.50– 9.00	8.75–10.25
Red lead, dry, in casks	9.75–11.25	9.50–10.00	9.75–11.25
Orange mineral, American, casks	11.75–13.50	11.50–12.00	11.75–13.25
Lead acetate, brown, broken, barrels	12.00–13.50	12.00–12.50	12.00–13.50
Lead arsenate, powdered, drums	13.50–15.00	13.00–15.00	13.00–15.00
Zinc oxide:			
American process, lead-free, bags, car lots	6.50	6.50	6.50
American process, leaded, barrels, car lots	6.75– 6.88	6.88	6.88
French process, red seal, bags, car lots	9.38	9.38	9.38
French process, green seal, bags, car lots	10.38	10.38	10.38
French process, white seal, barrels, car lots	11.63	11.63	11.63
Lithopone, American, bags, car lots	5.38	5.25	5.25
Zinc chloride:			
Solution,[1] drums	2.75– 4.00	2.75– 3.25	2.75– 3.25
Fused	5.25	5.25	5.25– 5.75
Zinc sulphate, barrels	3.00– 3.75	3.50– 3.75	3.00– 3.75

[1] At works.

The quotations for lead pigments are usually changed to reflect 25-point fluctuations in the price of pig lead. For this reason the price trend of lead pigments in 1929 was upward until November and downward thereafter in sympathy with the falling price of lead. Quotations on zinc pigments, however, were stable throughout the year at levels established in 1927, notwithstanding a substantial increase in the price of zinc up to October, 1929, which was followed by a sharp decrease in November and December. The price of high-strength lithopone, containing 50 per cent of zinc sulphide, was reduced to 7½ cents per pound in December to meet previous price cuts for titanium pigments.

COPPER[1]

BY C. E. JULIHN and H. M. MEYER[2]

INTRODUCTION

It is less true than formerly that the production of copper requires three operations—mining, smelting, and refining. All copper must be mined, but for years some Lake Superior copper has been smelted and sold as Lake copper without subsequent refining and a steadily increasing amount of copper is being extracted from ores by leaching methods which render smelting unnecessary. Nevertheless, it is still practicable to determine the copper production of the United States by three distinct sets of statistics which may be obtained, respectively, from the mines, the smelters, and the refineries.

These separate determinations of production are desirable because each of them has for certain purposes a particular advantage over the others. As they show different aspects of production, the three sets of figures will never agree exactly, but, taken together, they afford complete data on the output of copper.

Details of the geographic distribution of output are shown more precisely by statistics of mine production than by those of smelter and refinery production. Likewise, the character of the ores produced, their contents of copper and other valuable metals, and the treatment, other than smelting, they may have undergone can be learned accurately only from the mines themselves. On the other hand, mine statistics show only the estimated recoverable metal content of the ores.

The actual percentage of crude copper recovered from copper ores and from other ores having a low content of copper is shown by the smelter statistics. Lead and zinc ores, siliceous ores of the precious metals, and pyrite roasted in the manufacture of sulphuric acid often carry so little copper that the mines are not paid for it and do not report it, although these sources as a whole yield a considerable amount of copper. Another cause of difference between the figures of mine and of smelter production is the lag in time between the production and the smelting of an ore. For example, most of the ore mined in December of any year is not represented in the figures of smelter production for that year but enters into the figures of the year following. A third cause of difference between these two sets of figures is that the amount of metal contained in ore, matte, and other material held in stock at smelters is rarely the same at the beginning and the end of a year. Smelter statistics, as well as mine statistics, show broadly the geographic distribution of output.

The precise amount of copper made available for consumption in a given period, as well as that of the precious metals recovered from crude copper, is shown only by refinery statistics, but these afford little information on the distribution of output according to source and are uncertain even in their classification of the material refined as foreign or domestic.

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[1] Work on manuscript completed November, 1930.

[2] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Differences between smelter and refinery statistics are similar in origin to those existing between mine and smelter statistics, as some time must elapse after the copper is smelted before it is refined, and the quantity of copper in stocks of untreated or unfinished material at the beginning of the year differs from that at the end, not only at smelters but at the refineries as well.

Two or three months usually elapse between the day ore is mined and the day the copper derived from it becomes available for commercial use. Hence, the refinery statistics for the calendar year 1929 represent approximately the ore mined between October, 1928, and October, 1929. In periods when the course of production is little disturbed by pronounced fluctuations of activity the three sets of statistics should not differ greatly, but any decided fall or rise in production between October of one year and March of the year following tends to accentuate the differences among the three sets of figures.

In these reports the smelter output, including that of furnace-refined Lake copper as well as blister copper, has been adopted as the production of the country because smelter figures permit reasonably accurate determination of the distribution of copper production by States and give also the actual output of copper.

In order to have these figures maintain their value for showing the output of the country, it is necessary to include in them some copper produced directly through the leaching of ores and subsequent precipitation by electrolysis, although this fraction of the production is not actually smelted, as is the cement copper precipitated from solutions by means of scrap iron. Since this electrolytically precipitated copper is very pure, refineries merely resmelt it in order to cast it in commercial forms.

SUMMARY OF DOMESTIC AND WORLD STATISTICS

Summary of statistics of the copper industry in the United States, 1920–1929

	1920	1921	1922	1923	1924
Production of copper:					
Smelter output from domestic ores ... pounds	1,209,061,040	505,586,098	950,285,947	1,434,999,962	1,634,249,192
Mine production ... do	1,224,550,151	466,190,853	964,583,894	1,477,739,709	1,606,165,018
Refinery production of new copper—					
Electrolytic ... pounds	1,010,240,867	506,532,984	766,944,836	1,302,454,492	1,499,223,447
Lake ... do	153,483,952	100,918,001	122,545,126	137,691,306	145,333,227
Casting and pig ... do	18,698,421	1,963,271	15,180,723	24,019,197	29,657,925
Total domestic ... do	1,182,423,240	609,414,256	904,670,685	1,464,164,995	1,674,214,599
Total domestic and foreign ... do	1,526,165,346	950,777,815	1,255,515,959	1,979,835,616	2,260,076,010
Total new and old copper ... do	2,151,000,000	1,385,000,000	1,927,000,000	2,802,000,000	3,037,000,000
Ore produced:					
Copper ore ... short tons	36,765,370	13,396,382	26,893,247	45,519,317	49,178,315
Average yield of copper ... per cent	1.63	1.70	1.74	1.58	1.59
Copper-lead and copper-lead-zinc ores ... short tons	26,890	14,248	52,370	162,181	219,874
Average price per pound ... cents	18.4	12.9	13.5	14.7	13.1
Imports (unmanufactured) ... pounds	485,670,691	350,472,611	541,013,220	676,473,338	768,813,731
Exports of metallic copper[1] ... do	623,158,489	628,415,714	742,755,957	828,854,827	1,116,775.136
Withdrawn from total supply on domestic account:					
Total new copper ... pounds	1,053.838,558	610,988,744	896,633,833	1,300,473,331	1,354,742,564
Total new and old copper ... do	1,679,000,000	1,046,000,000	1,568,000,000	2,122,000,000	2,131,000,000
Stocks at end of year:					
Refined copper ... do	659,000.000	459,000,000	216,000,000	264,000,000	243,000,000
Blister and materials in solution ... pounds	465,000,000	283,000,000	361,000,000	432,000,000	393,000,000
Value of smelter production from domestic ores	$222,467,000	$65,221,000	$128,289,000	$210,945,000	$214,087,000
World production (smelter) ... pounds	2,114,349,000	1,229,277,000	1,904,793,000	2,683,025,000	2,987,263,000

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[1] See footnote at end of table.

Summary of statistics of the copper industry in the United States, 1920–1929—Con.

	1925	1926	1927	1928	1929
Production of copper:					
Smelter output from domestic ores pounds	1, 674, 869, 886	1, 739, 622, 094	1, 684, 040, 983	1, 825, 900, 393	2, 002, 863, 135
Mine production do	1, 678, 117, 747	1, 725, 275, 931	1, 649, 959, 370	1, 809, 796, 907	1, 995, 110, 398
Refinery production of new copper—					
Electrolytic pounds	1, 533, 995, 439	1, 553, 041, 424	1, 520, 076, 181	1, 607, 120, 026	1, 785, 754, 654
Lake do	138, 029, 764	172, 372, 304	195, 135, 199	179, 104, 311	185, 300, 917
Casting do	10, 870, 144	5, 883, 433	3, 740, 819	5, 573, 050	11, 676, 718
Total domestic do	1, 682, 895, 347	1, 731, 297, 161	1, 718, 952, 199	1, 791, 797, 387	1, 982, 732, 289
Total domestic and foreign pounds	2, 204, 573, 824	2, 322, 485, 376	2, 325, 763, 709	2, 487, 607, 779	2, 740, 112, 376
Total new and old copper do	3, 045, 000, 000	3, 282, 000, 000	3, 306, 000, 000	3, 560, 000, 000	3, 993, 000, 000
Ore produced:					
Copper ore short tons	53, 103, 014	57, 181, 894	56, 725, 460	62, 097, 132	[2] 68, 421, 853
Average yield of copper per cent	1. 54	1. 46	1. 41	1. 41	1. 41
Copper-lead and copper-lead-zinc ores short tons	228, 612	282, 015	418, 601	351, 131	259, 126
Average price per pound cents	14. 2	14. 0	13. 1	14. 4	17. 6
Imports (unmanufactured) pounds	652, 971, 407	779, 441, 803	718, 322, 990	787, 073, 640	974, 312, 201
Exports of metallic copper[1] do	1, 082, 369, 439	960, 220, 112	1, 069, 493, 121	1, 121, 186, 640	992, 895, 119
Withdrawn from total supply on domestic account:					
Total new copper pounds	1, 401, 012, 091	1, 570, 136, 207	1, 422, 959, 219	1, 608, 538, 878	1, 778, 585, 415
Total new and old copper do	2, 241, 000, 000	2, 530, 000, 000	2, 403, 000, 000	2, 681, 000, 000	3, 032, 000, 000
Stocks at end of year:					
Refined copper do	124, 000, 000	146, 000, 000	171, 000, 000	114, 000, 000	306, 000, 000
Blister and materials in solution pounds	432, 000, 000	455, 000, 000	401, 000, 000	423, 000, 000	500, 000, 000
Value of smelter production from domestic ores	$237, 832, 000	$243, 547, 000	$220, 609, 000	$262, 930, 000	$352, 504, 000
World production (smelter) pounds	3, 093, 085, 000	3, 216, 543, 000	3, 348, 821, 000	3, 769, 904, 000	4, 199, 805, 000

[1] Total exports of copper, exclusive of ore, concentrates, and composition metal, and for 1923–1929 of unrefined copper, figures for which are not separable from those for ore and concentrates. For 1926 and later years, exclusive also of "Other manufactures of copper," for which figures of quantity are not recorded.

[2] Includes old tailings.

Copper produced in the United States from domestic ores, 1924–1929

[Smelter output, in pounds fine]

State	1924	1925	1926	1927	1928	1929
Alaska	77, 053, 492	72, 204, 166	67, 631, 846	56, 489, 214	40, 541, 968	39, 867, 940
Arizona	672, 365, 115	722, 653, 457	729, 324, 537	681, 168, 117	735, 632, 406	829, 206, 475
California	49, 433, 716	46, 943, 604	30, 442, 961	25, 802, 603	24, 707, 992	33, 084, 232
Colorado	4, 158, 612	3, 163, 211	4, 657, 591	8, 006, 801	10, 262, 083	10, 519, 784
Idaho	3, 148, 519	3, 144, 064	1, 171, 262	1, 811, 103	2, 336, 654	6, 267, 487
Michigan	145, 333, 227	138, 029, 764	174, 778, 884	195, 135, 199	179, 104, 311	185, 300, 917
Missouri	184, 947	12, 114	54, 378	5, 041	930	1, 880
Montana	249, 322, 394	270, 604, 676	257, 271, 936	225, 208, 853	251, 046, 415	299, 894, 853
Nevada	77, 281, 479	77, 137, 563	109, 041, 769	118, 298, 342	159, 332, 977	138, 990, 247
New Mexico	78, 145, 629	76, 467, 245	82, 848, 096	79, 761, 222	92, 777, 233	100, 165, 206
North Carolina			1, 468, 746	5, 362, 041	8, 207, 000	(1)
Oregon	716, 656	126, 107	279, 223	484, 652	375, 049	739, 151
Pennsylvania	1, 263, 535	562, 240	495, 698	2, 149, 182	5, 013, 868	3, 581, 393
Tennessee	18, 251, 996	19, 789, 234	18, 601, 586	14, 498, 951	16, 374, 261	(1)
Texas	302	785	17, 102	25, 460	432, 968	393, 740
Utah	256, 531, 349	242, 730, 986	259, 649, 158	267, 705, 597	298, 375, 465	325, 965, 289
Vermont			446, 323	238, 143		752, 200
Washington	978, 647	1, 184, 807	1, 336, 617	1, 766, 953	1, 197, 340	1, 569, 260
Wyoming		331			2, 575	4, 305
Undistributed	79, 577	115, 532	104, 381	123, 509	178, 898	26, 558, 776
	1, 634, 249, 192	1, 674, 869, 886	1, 739, 622, 094	1, 684, 040, 983	1, 825, 900, 393	2, 002, 863, 135

[1] Included under "Undistributed." Bureau of Mines not at liberty to publish figures.

The following table shows the world smelter production of copper by countries where smelted but not necessarily where refined. So far as possible, material from scrap has been eliminated. As the figures for the United States for 1925 and 1926 do not include the smelter product from foreign ores, concentrates, and mattes, the content of the import of these materials has been included in the total for the world, in so far as can be done without duplication of figures shown elsewhere in the table.

World smelter production of copper, 1925–1929, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country [1]	1925	1926	1927	1928	1929
North America:					
Canada	22,180	30,199	31,947	56,619	72,661
Mexico	33,531	37,982	39,248	44,325	57,874
United States	[2] 759,708	[2] 789,075	[3] 843,850	[3] 911,444	[3] 998,789
	815,419	857,256	915,045	1,012,388	1,129,324
South America:					
Chile	177,082	188,875	226,160	274,900	303,200
Peru	[4] 36,864	[4] 42,940	46,377	52,292	53,962
	213,946	231,815	272,537	327,192	357,162
Europe:					
Austria	3,779	3,203	3,308	3,424	3,895
Belgium	11,140	10,006	9,810	[5] 9,720	[6] 10,000
Czechoslovakia	492	718	743	1,010	1,694
Finland	394	365	354	375	235
France	2,953	1,627	2,250	[6] 2,000	[6] 2,000
Germany [7]	39,100	46,200	50,600	48,500	53,600
Great Britain [8]	20,700	17,900	22,600	25,900	22,900
Italy	578	420	450	900	540
Norway	251	192	13	788	2,400
Rumania [9]	133	189	215	104	143
Russia [10]	9,042	10,634	13,597	[6] 20,000	[6] 25,000
Spain	21,298	23,925	28,689	27,758	28,455
Sweden [11]	3,727	3,894	5,406	3,396	4,748
Yugoslavia	7,301	9,671	12,863	15,086	20,675
	120,888	128,944	150,898	158,961	176,300
Asia:					
China [12]	1,048	2,068	1,052	4,395	[6] 4,000
Chosen	424	778	1,004	607	547
India, British					1,635
Japan	66,487	67,365	66,571	68,233	74,614
	67,959	70,211	68,627	73,235	80,800
Africa:					
Belgian Congo	90,104	80,639	89,156	[13] 111,510	[13] 135,539
Rhodesia—					
Northern	75	719	3,343	6,026	5,553
Southern	1,714	7		110	362
Union of South Africa	7,819	8,820	9,324	8,849	9,309
	99,712	90,185	101,823	126,495	150,763
Oceania:					
Australia	11,160	11,327	9,718	12,048	11,049
Papua [14]	89	173			
	11,249	11,500	9,718	12,048	11,049
	[15] 1,403,000	[15] 1,459,000	1,519,000	1,710,000	1,905,000

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[1] In addition to the countries listed, copper is smelted in Asiatic Turkey, but data of output are not available.

[2] Smelter output from domestic material, exclusive of scrap. The production of refined copper from domestic and foreign material, exclusive of scrap, is reported as follows, in metric tons: 1925, 999,973 tons; 1926, 1,053,456 tons; 1927, 1,054,943 tons; 1928, 1,128,354 tons; 1929, 1,242,888 tons.

[3] Smelter output from domestic and foreign material, exclusive of scrap. The production from domestic material only, exclusive of scrap, was as follows: 1927, 763,864 tons; 1928, 828,210 tons; 1929, 908,479 tons. Figures for smelter output from foreign ores not available prior to 1927.

[4] Includes copper contained in ores, concentrates, and mattes exported.

[5] Figures represent blister copper only. In addition to blister copper, Belgium reported in 1928 a large output of refined copper (41,690 tons) which is not included above as it is believed to have been produced principally from crude copper from the Belgian Congo and would, therefore, duplicate output reported under the latter country.

[6] Approximate production.

[7] Exclusive of material from scrap. (Metallgesellschaft, Stat. Zusammenstell.)

[8] Approximate production. (Imp. Inst., London.)

[9] Smelter output from domestic ores.

[10] Year ended Sept. 30.

[11] Exclusive of material from scrap.

[12] Exports of ingots and slabs.

[13] In addition to the crude copper smelted in the Belgian Congo, the following quantities were smelted in Belgium from matte and alloys produced in the Belgian Congo: 1928, 946 tons; 1929, 1,453 tons.

[14] Copper content of blister exported in year ended June 30 of year stated.

[15] Includes copper content of ores, concentrates, and mattes imported into the United States, not elsewhere included.

World mine production of copper, 1925–1929, in metric tons

[Compiled by L. M. Jones, of the Bureau of Mines]

Country[1]	1925	1926	1927	1928	1929
North America:					
Canada	50,553	60,371	63,569	91,941	112,545
Cuba[2]	14,135	9,028	13,433	6,431	4,604
Mexico	54,596	56,347	59,875	67,328	86,554
United States	761,177	782,568	748,405	820,906	904,962
	880,461	908,314	885,282	986,606	1,108,665
South America:					
Argentina[3]	800	800	800	800	800
Bolivia[4]	7,235	8,130	8,729	8,486	7,188
Chile	243,219	243,558	242,600	286,800	319,800
Peru	36,844	42,511	55,368	[5] 56,457	[5] 56,115
Venezuela	2,228	2,043	200	------	------
	290,326	297,042	307,697	352,543	383,903
Europe:					
Austria	1,840	2,238	2,332	3,035	2,100
Bulgaria[3]	1,000	1,700	1,300	1,000	2,000
Czechoslovakia	(6)	600	1,160	1,627	1,360
Finland	1,374	991	836	3,410	4,565
France	145	146	(7)	(7)	(7)
Germany	24,446	27,687	27,271	26,213	26,000
Great Britain	97	110	180	69	69
Greece	------	------	------	1	(7)
Hungary	5	22	(7)	(7)	(7)
Italy	826	1,490	1,690	822	[3] 800
Norway	31,693	6,207	12,367	15,779	18,890
Portugal[3]	2,000	2,000	2,000	2,000	2,000
Rumania[8]	133	189	215	104	143
Russia[9]	5,200	11,500	14,400	20,200	37,000
Spain	48,100	49,500	49,600	54,200	58,000
Sweden	213	709	783	619	1,128
Yugoslavia	9,693	12,100	12,900	15,100	15,200
	126,765	117,189	127,034	144,179	169,255
Asia:					
China[10]	1,048	2,068	1,052	4,395	[3] 4,000
Cyprus[4]	3,521	3,056	4,275	4,900	5,900
India, British	5,000	5,900	5,100	5,500	7,200
Japan—					
Japan proper[8]	66,487	67,365	66,571	68,233	74,614
Chosen[8]	424	778	1,004	607	547
Taiwan	689	1,717	1,384	1,300	6,100
	77,169	80,884	79,386	84,935	98,361
Africa:					
Algeria	468	489	273	230	61
Belgian Congo[8]	90,104	80,639	89,156	[11] 112,456	[11] 136,992
French Congo	300	384	1,121	61	(7)
Madagascar	(12)	------	------	------	------
Morocco, French	9	[4] 45	(7)	(7)	(7)
Rhodesia—					
Northern[8]	75	719	3,343	6,026	5,553
Southern[8]	1,714	7	------	110	362
South-West Africa	8,334	8,984	10,268	11,700	11,300
Tunisia	------	------	12	------	------
Union of South Africa[8]	7,819	8,820	9,272	8,849	9,309
	108,823	100,087	113,445	139,432	163,600
Oceania:					
Australia	12,007	8,862	10,133	9,618	13,018
Papua[13]	528	1,686	117	1	------
	12,535	10,548	10,250	9,619	13,018
	1,496,000	1,514,000	1,523,000	1,717,000	1,937,000

[1] In addition to the countries listed, copper is produced in Asiatic Turkey, but data of output are not available.

[2] Copper content of ore, concentrates, and matte imported into the United States.

[3] Approximate production.

[4] Copper content of exports.

[5] Figures represent output of the more important districts only, i. e., those reporting production of not less than 100 tons of fine copper.

[6] Production of 3,606 tons of copper ore reported, copper content not stated.

[7] Data not available.

[8] Smelter product.

[9] Year ended Sept. 30.

[10] Exports of ingots and slabs.

[11] Includes copper smelted in Belgium from mattes and alloys produced in the Belgian Congo as follows: 1928, 946 tons; 1929, 1,453 tons.

[12] Three tons of copper ore exported, content not stated.

[13] Copper content of exports for year ended June 30 of year stated.

GENERAL CONDITIONS

The favorable trends prevailing in the copper industry at the close of 1928 culminated in March, 1929, when world stocks of blister and refined copper were reduced to about 314,000 short tons and the price reached a peak of about 24 cents. The record world production, in April, 1929, amounted to nearly 197,000 tons. The peak price had been induced, however, by what amounted to a buyer's panic unwarranted by the actual relation of consumption to current production. There resulted a prompt reaction, with declining sales, lower price, curtailment of production, and rising stocks. In April, the price at refinery was stabilized at a little less than 18 cents, where it was held by Copper Exporters (Inc.) for the remainder of the year and in fact until April, 1930, when its further maintenance at so high a level became impossible. Production likewise declined, from its peak of nearly 197,000 tons in April to about 166,000 tons in December. This rate of production subsequently proved to be excessive with respect to the consumption requirements of 1930, a year of world-wide industrial depression. World stocks had risen to about 466,000 tons at the close of 1929, and continued to mount rapidly thereafter.

In the United States in 1929 both the production and the consumption of copper were the highest yet recorded. Stocks at the beginning of 1929 stood at the lowest figure since the end of 1917, but at the end of 1929 they were higher than at any time since the end of 1920, having increased 50 per cent during the year. This increase in stocks was due in part to the increase of unmanufactured copper imports to a record figure coincident with a 7 per cent drop in exports from the average of the five preceding years.

In 1929 North and South America supplied 78 per cent of the world copper production, about 59 per cent being derived from the former and 19 per cent from the latter. The 22 per cent supplied by the rest of the world included about 9 per cent derived from Europe, about 8 per cent from Africa, and about 4 per cent from Asia (Japan).

Rank of continents in copper production, 1928 and 1929

Continent	Per cent of world total		Continent	Per cent of world total	
	1928	1929		1928	1929
North America	59.20	59.28	Africa	7.40	7.91
South America	19.13	18.74	Asia	4.28	4.24
Europe	9.29	9.25	Australia	.70	.58
				100.00	100.00

A little more than half of the world production of copper is supplied by the United States and about three-fourths by the United States, together with Chile and Belgian Congo, next in importance as producers. Japan, Canada, Mexico, Peru, and Germany, each of which produces less than 4 per cent but more than 2 per cent of the total, together contribute about 16 per cent of the world total. The output of the eight countries mentioned amounts to about 92 per cent of the world total. Spain, Russia, and Great Britain together provide about 4 per cent of the total. Minor production was made in 1929 by 17 other countries.

Rank of countries in copper production, 1928 and 1929

Rank in 1929	Country	Per cent of world total					
		1928			1929		
1	United States	53.30	75.90	91.69	52.43	75.46	91.87
2	Chile	16.08			15.92		
3	Belgian Congo	6.52			7.11		
4	Japan	3.99	15.79		3.92	16.41	
5	Canada	3.31			3.81		
6	Mexico	2.59			3.04		
7	Peru	3.06			2.83		
8	Germany	2.84			2.81		
9	Spain	1.62	4.30		1.50	4.01	
10	Russia	1.17			1.31		
11	Great Britain	1.51			1.20		
	Other countries	4.01			4.12		
		100.00			100.00		

In 1929 world production of new copper, as estimated by the Bureau of Mines from official reports, was 2,100,000 short tons, an increase of 215,000 tons, or 11 per cent, over the 1,885,000 tons produced in 1928. All of the continents except Australia contributed to the increase—the Americas, 162,000 tons; Africa, 27,000 tons; Europe, 16,000 tons; and Asia, 8,000 tons. Australian production decreased about 1,000 tons. Nearly all of the important copper-producing countries likewise increased their production, notably the United States, with an increase of 96,283 tons; Chile, with 31,195 tons; Belgian Congo, with 26,487 tons; Canada, with 17,683 tons; and Mexico, with 14,935 tons. These five countries together contributed a total increase of 186,583 tons. Japan, Yugoslavia, Germany, and Russia increased their production 7,034 tons, 6,161 tons, 5,622 tons, and 5,600 tons, respectively. The production in Great Britain decreased 3,307 tons.

Although with two exceptions the actual increases by the producing countries were generally substantial, there were few striking changes in their relative positions and shares in the world total. The largest change in per cent of world's total was that of the United States, which dropped from 53.30 per cent in 1928 to 52.43 per cent in 1929, in spite of the fact that its production from domestic ores increased 88,482 tons, or 9.69 per cent, and its production from foreign ores increased 7,801 tons, or 8.5 per cent, the total increase from both sources being 9.58 per cent.

Belgian Congo, Canada, and Mexico made the most noticeable gains in per cent of total world production. On the whole, however, the changes in proportions of world production from the various countries were relatively slight, as shown by the following table.

Production of copper by principal producing countries and changes in relative importance of these sources, 1928 and 1929

	Short tons		Per cent of world total		Increase or decrease		Change in per cent of world total
	1928	1929	1928	1929	Tons	Per cent	
World smelter production	1,885,000	2,100,000	100.00	100.00	+215,000	+11.41	----------
North and South America	1,476,632	1,638,568	78.33	78.02	+161,936	+10.97	−0.31
North America	1,115,965	1,244,865	59.20	59.28	+128,900	+11.55	+.08
United States	1,004,700	1,100,983	53.30	52.43	+96,283	+9.58	−.87
From domestic ores	912,950	1,001,432	48.43	47.69	+88,482	+9.69	−.74
From foreign ores	91,750	99,551	4.87	4.74	+7,801	+8.50	−.13
Canada	62,412	80,095	3.31	3.81	+17,683	+28.33	+.50
Mexico	48,860	63,795	2.59	3.04	+14,935	+30.57	+.45
South America	360,667	393,703	19.13	18.74	+33,036	+9.16	−.39
Chile	303,025	334,220	16.08	15.92	+31,195	+10.29	−.16
Peru	57,642	59,483	3.06	2.83	+1,841	+3.19	−.23
Europe	175,481	191,692	9.29	9.25	+16,211	+9.24	−.04
Germany	53,462	59,084	2.84	2.81	+5,622	+10.52	−.03
Great Britain	28,550	25,243	1.51	1.20	—3,307	−11.58	−.31
Russia	22,000	27,600	1.17	1.31	+5,600	+25.45	+.14
Spain	30,598	31,366	1.62	1.50	+768	+2.51	−.12
Yugoslavia	16,629	22,790	.88	1.09	+6,161	+37.05	+.21
Asia	80,728	89,067	4.28	4.24	+8,339	+10.33	−.04
Japan	75,214	82,248	3.99	3.92	+7,034	+9.35	−.07
Africa	139,437	166,188	7.40	7.91	+26,751	+19.19	+.51
Belgian Congo	122,919	149,406	6.52	7.11	+26,487	+21.55	+.59
Oceania	13,281	12,179	.70	.58	−1,102	−8.30	−.12

The world's visible stocks of copper (exclusive of consumers' stocks) increased 134,000 tons in 1929, after having decreased about 81,000 tons through 1927 and 1928.

The average price of copper in the United States during 1929 was 17.6 cents, as determined by total sales reported to the Bureau of Mines. An average slightly above 18 cents results from an average of monthly averages, as published by reputable journals. This latter average may be determined promptly at the end of the year, but the former, representing the exact yearly average price, is necessarily delayed until annual returns from all selling agencies can be compiled.

From annual estimates of world consumption compiled by the American Bureau of Metal Statistics it may be shown that in recent years nearly 51 per cent of world consumption has been taken by North America, about 43 per cent by Europe, less than 5 per cent by Japan, and the remainder, less than 2 per cent, by the rest of the world.

World consumption of copper, 1925–1929, in per cent

	1925	1926	1927	1928	1929	Average of averages, 1925–1929
North America	49.1	53.1	47.4	49.2	54.3	50.6
Europe	43.8	39.6	46.1	44.8	40.5	42.9
Japan	4.9	5.2	4.7	4.4	3.7	4.6
	97.8	97.9	98.2	98.4	98.5	98.1

In 1929 the apparent increase in world consumption was 67,000 short tons. Although the increase for the United States was nearly 136,000 tons, for France 12,500 tons, and for Sweden 5,300 tons, consumption by Germany decreased nearly 41,000 tons, by Italy nearly 25,000 tons, by Japan nearly 13,000 tons, and by Great Britain 10,500 tons.

A notable feature of the year was the challenge by European consumers of price fixing by American exporters of copper. These consumers held that the extreme rise of price in 1929 and the later fixing of the export price at about 18 cents were both unwarranted.

In Africa the completion of plant improvements at Katanga resulted in an increase in production from its six active mines to 2,225,000 metric tons of ore that yielded nearly 137,000 metric tons of copper. About 112,000 metric tons of copper had been produced in 1928. In anticipation of early railroad connections to the west coast, preparations have been made to extend operations to the western group of Katanga mines and plans for mining and metallurgical installations are being made. A dam to be used in connection with generation of electrical power is being constructed upon the Musonoï River. In Northern Rhodesia rapid progress was made in exploration and development of the extensive deposits of copper ore that promise important contributions to future production. Valuable data in regard to these deposits have been published recently by officials of Rhodesian Selection Trust.[3]

The following interesting summary by Parsons[4] with regard to operations in Northern Rhodesia broadly suggests the nature of future possibilities.

Ore reserves, production, and operating costs at principal copper properties in Northern Rhodesia

[From a compilation by A. B. Parsons]

Property	Ore resources			
	Official estimate		Conjecture based on semiofficial data	
	Tons	Grade	Tons	Grade
Bwana M'Kubwa	3,000,000	3.8	7,000,000	3.8
Roan Antelope (including Roan Antelope Extension and Muliashi)	50,000,000	3.4	250,000,000	3.4
N'Kana	36,000,000	4.3	100,000,000	4.2
Mufulira	45,000,000	5.0	100,000,000	5.0
N'Changa	35,000,000	3.8	75,000,000	3.5
Chambishi (and or other area in N'Kana Concession)	12,000,000	3.0	50,000,000	3.0
N'Changa West Extension (and or other area in R. C. B. Concession)			50,000,000	6.0
Total	181,000,000		632,000,000	

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[3] Gray, Anton, Geology and Ore Deposits of the N'Kana Concession: London, 1929.
Sharpstone, D. C., Geology and Development of the Roan Antelope Mine· London, 1929.
Bancroft, J. A., and Pelletier, R. A., General Geology of Northern Rhodesia: Internat. Geol. Cong., 14th Sess., Pretoria, S. A., 1929.

[4] Parsons, A. B., Corporate Relations of Northern Rhodesian Mining Companies: Eng. and Min. Jour., vol. 128, No. 15, Oct. 12, 1929, p. 579.

Ore reserves, production, and operating costs at principal copper properties in Northern Rhodesia—Continued

Property	Production from initial unit			Possible annual production in 1939 (pounds of copper)
	Ore per day (tons)	Copper per year (pounds)	Cost including taxes and depreciation (cents per pound)	
Bwana M'Kubwa	1,000	15,000,000	16.0–16.5	15,000,000
Roan Antelope (including Roan Antelope Extension and Muliashi)	5,000	100,000,000	9.5–10.0	250,000,000
N'Kana	5,000	125,000,000	9.0– 9.5	250,000,000
Mufulira	5,000	150,000,000	9.0– 9.5	250,000,000
N'Changa	5,000	100,000,000	11.0–11.5	150,000,000
Chambishi (and or other area in N'Kana Concession)	3,000	50,000,000	10.0–10.5	50,000,000
N'Changa West Extension (and or other area in R. C. B. Concession	3,000	100,000,000	10.0–10.5	100,000,000
Total				1,065,000,000

Subsequent estimates of reserves[5] increase those of Roan Antelope to 75,000,000 tons, of N'Kana to 60,000,000 tons, of N'Changa to 59,000,000 tons, of Chambishi to 20,000,000 tons, and of N'Changa West Extension to 39,000,000 tons (8.5 per cent ore).

Recent increase in Canadian mine production of copper is shown by the following table.

Mine production of copper in Canada, 1925 and 1929, in short tons

	1925	1929
British Columbia	34,611	51,952
Ontario	19,859	44,440
Quebec	1,255	27,668
	55,725	124,060

This increase of 68,335 tons, or 123 per cent, in four years is impressive and foreshadows further increases.

By the end of 1930 Manitoba is expected to provide 15,000 tons of blister copper from the Flin Flon smelter of the Hudson Bay Mining & Smelting Co.

In Quebec the Noranda mine is the principal producer. It is constructing the second unit of its smelter to provide a yearly capacity of about 35,000 tons of blister copper.

In British Columbia the chief producers of copper are the Granby Consolidated Mining, Smelting & Power Co. (Ltd.), operating at Anyox and at Copper Mountain, and the Britannia Mining & Smelting Co. (Ltd.), operating the Britannia mine on Howe Sound. These operations have been at full capacity and only moderate increases are to be expected of them.

The International Nickel Co. of Canada (Ltd.) is responsible for practically the entire production in Ontario. Its development of the remarkable ore body of the Frood mine is said to have proved 125,000,000 tons of copper-nickel ore rumored to contain more than 5 per cent of copper. It is difficult to forecast the effect of such an increase of reserves upon Canadian production. The Frood mine is expected to support production of about 8,000 tons a day, gradually relieving pressure for production from the Creighton mine, now yielding

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[5] Bateman, Alan, The Rhodesian Copper Deposits: Canadian Min. & Met. Bull., No. 216, April, 1930, pp. 477–513.

6,000 tons daily. At Copper Cliff the smelting plant is being extensively remodeled for increased capacity and a new copper refinery is under construction to have an initial capacity of 120,000 tons a year. It is not at all difficult to foresee an annual production of 200,000 tons of copper from Canada.

Withal it still remains to be seen whether increased production from Africa and Canada, although of most substantial proportions, will prove excessive with steadily mounting world requirements for the metal.

PRODUCTION

SMELTER PRODUCTION

The copper output of the United States smelters from domestic ores in 1929 was 2,002,863,135 pounds, exceeding the previous record output of 1916 by 75,012,587 pounds and representing 48 per cent of the world copper production. The United States percentage of the world total has been as follows:

	Per cent		Per cent		Per cent
1913	56	1922	50	1926	54
1918	61	1923	53	1927	50
1920	57	1924	55	1928	48
1921	41	1925	54	1929	48

Copper produced (smelter output) in the United States, 1845–1929

[Values rounded]

Year	Quantity	Increase	Value	Year	Quantity	Increase	Value
	Pounds	*Pounds*			*Pounds*	*Pounds*	
1845	224, 000		$45, 000	1889	226, 775, 962	414, 496	$30, 615, 000
1846	336, 000	112, 000	57, 000	1890	259, 763, 092	32, 987, 130	40, 523, 000
1847	672, 000	336, 000	124, 000	1891	284, 121, 764	24, 358, 672	36, 368, 000
1848	1, 120, 000	448, 000	218, 000	1892	344, 998, 679	60, 876, 915	40, 020, 000
1849	1, 568, 000	448, 000	349, 000	1893	329, 354, 398	[1] 15, 644, 281	35, 570, 000
1850	1, 456, 000	[1] 112, 000	320, 000	1894	354, 188, 374	24, 833, 976	33, 648, 000
1851	2, 016, 000	560, 000	334, 000	1895	380, 613, 404	26, 425, 030	40, 726, 000
1852	2, 464, 000	448, 000	542, 000	1896	460, 061, 430	79, 448, 026	49, 687, 000
1853	4, 480, 000	2, 016, 000	985, 000	1897	494, 078, 274	34, 016, 844	59, 289, 000
1854	5, 040, 000	560, 000	1, 108, 000	1898	526, 512, 987	32, 434, 713	65, 288, 000
1855	6, 720, 000	1, 680, 000	1, 814, 000	1899	568, 666, 921	42, 153, 934	97, 242, 000
1856	8, 960, 000	2, 240, 000	2, 419, 000	1900	606, 117, 166	37, 450, 245	100, 615, 000
1857	10, 752, 000	1, 792, 000	2, 688, 000	1901	602, 072, 519	[1] 4, 044, 647	100, 546, 000
1858	12, 320, 000	1, 568, 000	2, 833, 000	1902	659, 508, 644	57, 436, 125	80, 460, 000
1859	14, 112, 000	1, 792, 000	3, 104, 000	1903	698, 044, 517	38, 535, 873	95, 632, 000
1860	16, 128, 000	2, 016, 000	3, 709, 000	1904	812, 537, 267	114, 492, 750	104, 005, 000
1861	16, 800, 000	672, 000	3, 696, 000	1905	888, 784, 267	76, 247, 000	138, 650, 000
1862	21, 160, 000	4, 360, 000	4, 655, 000	1906	917, 805, 682	29, 021, 415	177, 136, 000
1863	19, 040, 000	[1] 2, 120, 000	6, 473, 000	1907	868, 996, 491	[1] 48, 809, 191	173, 799, 000
1864	17, 920, 000	[1] 1, 120, 000	8, 422, 000	1908	942, 570, 721	73, 574, 230	124, 419, 000
1865	19, 040, 000	1, 120, 000	7, 473, 000	1909	1, 092, 951, 624	150, 380, 903	142, 084, 000
1866	19, 936, 000	896, 000	6, 828, 000	1910	1, 080, 159, 509	[1] 12, 792, 115	137, 180, 000
1867	22, 400, 000	2, 464, 000	5, 682, 000	1911	1, 097, 232, 749	17, 073, 240	137, 154, 000
1868	25, 984, 000	3, 584, 000	5, 976, 000	1912	1, 243, 268, 720	146, 035, 971	205, 139, 000
1869	28, 000, 000	2, 016, 000	6, 790, 000	1913	1, 224, 484, 098	[1] 18, 784, 622	189, 795, 000
1870	28, 224, 000	224, 000	5, 977, 000	1914	1, 150, 137, 192	[1] 74, 346, 906	152, 968, 000
1871	29, 120, 000	896, 000	7, 023, 000	1915	1, 388, 009, 527	237, 872, 335	242, 902, 000
1872	28, 000, 000	[1] 1, 120, 000	9, 956, 000	1916	1, 927, 850, 548	539, 841, 021	474, 288, 000
1873	34, 720, 000	6, 720, 000	9, 721, 000	1917	1, 886, 120, 721	[1] 41, 729, 827	514, 911, 000
1874	39, 200, 000	4, 480, 000	8, 624, 000	1918	1, 908, 533, 595	22, 412, 874	471, 408, 000
1875	40, 320, 000	1, 120, 000	9, 152, 000	1919	1, 286, 419, 329	[1] 622, 114, 266	239, 274, 000
1876	42, 560, 000	2, 240, 000	8, 937, 000	1920	1, 209, 061, 040	[1] 77, 358, 289	222, 467, 000
1877	47, 040, 000	4, 480, 000	8, 937, 000	1921	505, 586, 098	[1] 703, 474, 942	65, 221, 000
1878	48, 160, 000	1, 120, 000	7, 994, 000	1922	950, 285, 947	444, 699, 849	128, 289, 000
1879	51, 520, 000	3, 360, 000	9, 582, 000	1923	1, 434, 999, 962	484. 714, 015	210, 945, 000
1880	60, 480, 000	8, 960, 000	12, 943, 000	1924	1, 634, 249, 192	199, 249, 230	214, 087, 000
1881	71, 680, 000	11, 200, 000	13, 046, 000	1925	1, 674, 869, 886	40, 620, 694	237, 832, 000
1882	90, 646, 232	18, 966, 232	17, 313, 000	1926	1, 739, 622, 094	64, 752, 208	243, 547, 000
1883	115, 526, 053	24, 879, 821	19, 062, 000	1927	1, 684, 040, 983	[1] 55, 581, 111	220, 609, 000
1884	144, 946, 653	29, 420, 600	18, 843, 000	1928	1, 825, 900, 393	141, 859, 410	262, 930, 000
1885	165, 875, 483	20, 928, 830	17, 915, 000	1929	2, 002, 863, 135	176, 962, 742	352, 504, 000
1886	157, 763, 043	[1] 8, 112, 440	17, 512, 000				
1887	181, 477, 331	23, 714, 288	25, 044, 000		43, 054, 487, 162		7, 032, 026, 000
1888	226, 361, 466	45, 440, 942	38, 029, 000				

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[1] Decrease.

The figures of smelter production in 1929 are based on confidential returns from all known smelting companies handling copper-bearing materials from the United States. Sincere thanks are extended to all companies and officials who have aided in furnishing this information and have given valuable time to answering inquiries concerning distribution of the output. The following list gives the names of the owning or operating companies, the location, and the final copper product of smelting and refining plants treating material from the United States during 1929. It does not include lead and zinc plants that recovered copper as a by-product from mixed ores. Lists of lead and zinc smelters may be found in the chapters on those metals.

Copper-reduction plants that treated materials from the United States in 1929

Location	Company	Final copper product
Arizona:		
Ajo	New Cornelia Copper Co	Electrolytic.
Clarkdale	United Verde Copper Co	Blister.
Clemenceau	United Verde Extension Mining Co	Do.
Clifton	Phelps Dodge Corporation	Blister and casting.
Douglas	Calumet & Arizona Mining Co	Blister.
Do	Phelps Dodge Corporation	Do.
Hayden	American Smelting & Refining Co	Do.
Inspiration	Inspiration Consolidated Copper Co	Electrolytic.
Miami	International Smelting Co	Blister.
Superior	Magma Copper Co	Do.
Maryland: Baltimore	American Smelting & Refining Co	Electrolytic and casting.
Michigan:		
Hancock	Quincy Mining Co	Anodes and Lake.
Houghton	Michigan Smelting Co	Do.
Hubbell	Calumet & Hecla Consolidated Copper Co	Do.
Montana:		
Anaconda	Anaconda Copper Mining Co	Blister.
Great Falls	do	Electrolytic.
Nevada:		
McGill	Nevada Consolidated Copper Co	Blister.
Thompson	Mason Valley Mines Co	Do.
New Jersey:		
Chrome	United States Metals Refining Co	Blister and electrolytic.
Maurer	American Smelting & Refining Co	Do.
Perth Amboy	Raritan Copper Works	Electrolytic.
New York: Laurel Hill	Nichols Copper Co	Blister and electrolytic.
Tennessee:		
Copperhill	Tennessee Copper Co	Blister.
Isabella	Ducktown Chemical & Iron Co	Do.
Texas: El Paso	American Smelting & Refining Co	Do.
Utah:		
Garfield	do	Do.
International	International Smelting Co	Do.
Washington: Tacoma	American Smelting & Refining Co	Blister, electrolytic, and casting.

The figures of production represent the actual smelter recovery. For Michigan it is the sum of furnace-refined copper and copper cast into anodes for electrolytic refining. As to blister copper, the figures represent the fine copper content. Some casting and electrolytic copper is produced direct from ore or matte, and this is included in the smelter production. Metallic and cement copper recovered by leaching is also included in smelter production.

MINE PRODUCTION

The figures of mine production are based on reports furnished to the Bureau of Mines by all mines producing copper. The mines and smelters of several of the large copper producers are under the same management, and their production is reported on the same basis. The figures furnished by mines that ship to custom smelters or have only matting furnaces and ship their matte for conversion are likely to differ considerably from the smelter returns, as the mines may report a considerable quantity that has not reached the stage of blister copper by the end of the year and is consequently not included in the smelter production, or material that was reported by the mines in one year may be treated by the smelters in the following year. This discrepancy is more pronounced if a marked change in rate of production occurs at the beginning or the end of the year, so that there is not the balance of overlap that occurs if the industry is in normal condition throughout the year. Considerable copper is recovered by the smelters from ores that are treated primarily for other metals, the copper content being so low that it is not paid for and consequently is not always reported by the mines. The difference between the smelter and the refinery production is accounted for by change in the stocks of blister copper and bluestone and the loss in refining.

Although data on smelter and refinery production in a calendar year become available about the middle of the following year, figures on mine production seldom become available before the end of the year as they are more difficult to obtain and require more time for computation.

Beginning with the present chapter on copper, such detailed figures on mine production as are available at the time of writing will be used.

Copper produced from domestic ores, as reported by mines, smelters, and refineries, 1920–1929, in pounds

Year	Mine	Smelter	Refinery
1920	1, 224, 550, 151	1, 209, 061, 040	1, 182, 423, 240
1921	466, 190, 853	505, 586, 098	609, 414, 256
1922	964, 583, 894	950, 285, 947	904, 670, 685
1923	1, 477, 739, 709	1, 434, 999, 962	1, 464, 164, 995
1924	1, 606, 165, 018	1, 634, 249, 192	1, 674, 214, 599
1925	1, 678, 117, 747	1, 674, 869, 886	1, 682, 895, 347
1926	1, 725, 275, 931	1, 739, 622, 094	1, 731, 297, 161
1927	1, 649, 959, 370	1, 684, 040, 983	1, 718, 952, 199
1928	1, 809, 796, 907	1, 825, 900, 393	1, 791, 797, 387
1929	1, 995, 110, 398	2, 002, 863, 135	1, 982, 732, 289

PRODUCTION BY STATES

The mine and smelter production figures, by States, for 1928 and 1929 are shown in the table following; in the second table following the smelter production from 1845 through 1929, by States, is shown. Arizona, Utah, Montana, and Michigan led in production for 1929 with 82 per cent of the smelter output; if the production of Nevada, New Mexico, and Alaska is added to the output of these States, 96 per cent of the output of the country is represented. In total production from 1845 through 1929, Arizona, Montana, and Michigan are especially impressive, having made 32.32, 23.24, and 19.14 per cent, respectively, of the country's total output, and Utah stands fourth with 10.10 per cent; the four States together have produced 85 per cent of the total. If the production of Nevada, New Mexico, Alaska, and California is added to that of the four States mentioned, 97 per cent of the country's total output is represented.

Copper produced in the United States, 1928 and 1929, according to smelter and mine returns, by States, in pounds

State	1928		1929		
	Smelter returns	Mine returns	Smelter returns		Mine returns
			Percentage of total	Quantity	
Alaska	40,541,968	41,421,000	1.99	39,867,940	40,510,000
Arizona	735,632,406	732,276,803	41.40	829,206,475	830,628,411
California	24,707,992	25,150,743	1.65	33,084,232	33,218,994
Colorado	10,262,083	8,594,646	.53	10,519,784	8,905,074
Idaho	2,336,654	2,072,165	.31	6,267,487	5,131,438
Michigan	179,104,311	178,442,704	9.25	185,300,917	186,402,218
Missouri	930	65,000	--------	1,880	2,240
Montana	251,046,415	248,262,027	14.97	299,894,853	297,725,973
Nevada	159,332,977	158,876,883	6.94	138,990,247	140,138,809
New Mexico	92,777,233	89,854,646	5.00	100,165,206	97,717,262
North Carolina	8,207,000	8,207,000	(1)	(1)	(1)
Oregon	375,049	358,463	.04	739,151	655,746
Pennsylvania	5,013,868	4,977,885	.18	3,581,393	3,454,170
Tennessee	16,374,261	16,374,261	(1)	(1)	(1)
Texas	432,968	447,792	.02	393,740	341,000
Utah	298,375,465	293,235,039	16.27	325,965,289	318,282,523
Vermont	--------	--------	.04	752,200	(1)
Washington	1,197,340	1,177,246	.08	1,569,260	1,400,489
Wyoming	2,575	2,604	--------	4,305	4,301
Undistributed	178,898	--------	1.33	26,558,776	30,591,750
	1,825,900,393	1,809,796,907	100.00	2,002,863,135	1,995,110,398

[1] Included under "Undistributed." Bureau of Mines not at liberty to publish figures.

Copper produced in the United States, 1845–1929, by States

[Smelter output]

State	Pounds	Percentage	Rank
Alaska	1,157,595,157	2.69	7
Arizona	13,914,970,235	32.32	1
California	1,054,083,426	2.45	8
Colorado	339,352,602	.79	10
Idaho	139,498,727	.32	11
Michigan	8,239,296,838	19.14	3
Montana	10,004,438,776	23.24	2
Nevada	1,721,485,350	4.00	5
New Mexico	1,313,016,526	3.05	6
Oregon	20,379,123	.05	14
Tennessee	[1] 519,017,000	(2)	9
Utah	4,349,304,659	10.10	4
Washington	26,937,081	.06	13
Wyoming	31,680,017	.07	12
Other States and unapportioned	[3] 223,431,645	[3] .52	--------
	43,054,487,162	--------	--------

[1] Approximate production through 1928. Figures for 1929 are confidential and are included under "Other States and unapportioned."

[2] Bureau of Mines not at liberty to publish figures.

[3] Includes Tennessee for 1929.

Mine production of copper in the principal districts, 1928 and 1929

[Districts that produced over 1,000,000 pounds]

District or region	State	1928		1929	
		Mine output (pounds)	Percentage of total production	Mine output (pounds)	Percentage of total production
Bingham	Utah	287,685,000	15.90	311,892,000	15.63
Butte	Montana	247,067,000	13.65	296,316,000	14.85
Yavapai County (mostly Jerome district).	Arizona	165,297,000	9.13	208,172,000	10.43
Globe-Miami	do	160,430,000	8.86	191,596,000	9.60
Lake Superior	Michigan	178,443,000	9.86	186,402,000	9.34
Bisbee (Warren)	Arizona	161,492,000	8.92	186,130,000	9.33
Ely (Robinson)	Nevada	141,969,000	7.84	130,755,000	6.55
Central (including Santa Rita)	New Mexico	80,239,000	4.43	87,446,000	4.38
Ajo	Arizona	[1]77,995,000	4.31	71,003,000	3.56
Ray (Mineral Creek)	do	68,661,000	3.79	66,287,000	3.32
Morenci-Metcalf	do	54,053,000	2.99	56,781,000	2.85
Pioneer	do	36,655,000	2.03	39,115,000	1.96
Plumas County	California	21,141,000	1.17	24,929,000	1.25
Shasta County	do	3,056,000	.17	6,034,000	.30
Banner	Arizona	1,799,000	.10	5,040,000	.25
Lordsburg	New Mexico	4,625,000	.26	4,248,000	.21
Lebanon (Cornwall mine)	Pennsylvania	4,978,000	.28	3,454,000	.17
Yerington	Nevada	10,988,000	.61	3,270,000	.16
Tintic	Utah	2,457,000	.14	3,166,000	.16
Battle Mountain	Colorado	1,219,000	.07	3,139,000	.16
Alder Creek	Idaho	(2)		2,824,000	.14
Bonanza	Colorado	4,300,000	.24	2,667,000	.13
Willow Creek	New Mexico	2,120,000	.12	2,641,000	.13
Jack Rabbit	Nevada	2,026,000	.11	2,638,000	.13
Park City	Utah	2,639,000	.15	2,524,000	.13
Battle Mountain	Nevada	3,075,000	.17	2,432,000	.12
Silver Bell	Arizona	2,856,000	.16	2,384,000	.12
Eureka	Colorado	1,487,000	.08	1,616,000	.08
Pastura	New Mexico	1,200,000	.07	1,500,000	.08
Index	Washington	(3)	(3)	1,296,000	.06
Foothill belt	California	(2)		1,210,000	.06
Burro Mountain	New Mexico	(2)		1,085,000	.05
Copper River [4]	Alaska	(3)	(3)	(3)	(3)
Prince William Sound [4]	do	(3)	(3)	(3)	(3)
Swain County [4]	North Carolina	8,207,000	.45	(3)	(3)
Ducktown [4]	Tennessee	16,374,000	.90	(3)	(3)

[1] As shown in New Cornelia Copper Co.'s annual report to stockholders.

[2] Less than 1,000,000 pounds.

[3] Not at liberty to publish figures.

[4] Not listed in order of output.

Copper produced in some of the principal districts to the end of 1929

District or region	State	Date production began	Pounds	Per cent	Rank
Butte	Montana	1868	9,935,112,000	23.08	1
Lake Superior	Michigan	1845	8,200,774,000	19.05	2
Bisbee	Arizona	1880	3,942,042,000	9.16	3
Bingham	Utah	1896	3,935,154,000	9.14	4
Globe-Miami	Arizona	1881	3,131,069,000	7.27	5
Jerome	do	1883	(1)	(1)	6
Morenci-Metcalf	do	1873	1,892,062,000	4.39	7
Ely (Robinson)	Nevada	1908	1,542,289,000	3.58	8
Central (including Santa Rita)	New Mexico	1800	1,155,077,000	2.68	9
Ray (Mineral Creek)	Arizona	1911	1,085,080,000	2.52	10
Ajo	do	(2)	[3]670,855,000	1.56	11
Shasta County	California	1897	633,414,000	1.47	12
Ducktown	Tennessee	1850	(4)	(4)	13
Pioneer	Arizona	(2)	[5]259,657,000	.60	14
Plumas County	California	1865	245,149,000	.57	15
Tintic	Utah	1880	182,012,000	.42	16
Foothill belt	California	1862	173,569,000	.40	17

[1] Bureau of Mines not at liberty to publish figures for Jerome district separately for 1924–1929. The total through 1923 was 1,556,324,000 pounds.

[2] Not recorded.

[3] From 1907–1929, inclusive.

[4] Bureau of Mines not at liberty to publish figures for Ducktown district separately for 1929. The total through 1928 was 519,562,000 pounds.

[5] From 1904–1929, inclusive.

QUANTITY AND ESTIMATED RECOVERABLE CONTENT OF COPPER-BEARING ORES

The following tables show the quantity and the estimated recoverable copper content of the ore produced by the mines of the United States in 1925 to 1928. The figures are taken from the mine reports in Mineral Resources. Detailed figures for 1929 are not available at time of writing. The close agreement between the output as reported by the smelters and the recoverable quantity as reported by the mines indicates that the estimated recoverable tenor is very close to the actual recovery. The classification of some of the complex western ores is difficult and more or less arbitrary. Under copper ores are classed not only those that contain 2.5 per cent or more of copper but those that contain less than this percentage if they are valuable chiefly for copper. Under copper-lead and copper-lead-zinc ores are classed complex ores in which copper is a valuable constituent. Mines report considerable copper from ores mined primarily for other metals. These include siliceous gold and silver ores, lead ores, zinc ores, pyritic sulphur ores, and ores concentrated for their content of other metals.

Copper produced in the United States in 1928 from ores in which copper constitutes the principal value

State	Copper ore (short tons)	Copper produced		Gold produced (fine ounces)	Silver produced (fine ounces)	Value of gold and silver per ton of ore
		Pounds	Percentage			
Alaska	579,500	41,421,000	3.57	------------	350,430	$0.35
Arizona	22,583,844	[1] 718,442,138	1.59	161,008.39	[2] 5,884,088	.30
California	900,791	[3] 24,751,199	1.37	16,664.75	411,695	.65
Colorado	11,983	1,299,636	5.42	769.31	235,581	12.83
Idaho	31,454	1,058,944	1.68	559.38	262,938	5.26
Michigan	7,361,658	178,442,704	1.21	------------	17,153	[4] .43
Montana	3,147,671	[5] 236,897,019	3.76	33,231.70	5,657,808	1.27
Nevada	6,244,047	156,746,489	1.26	68,530.96	258,519	.25
New Mexico	3,733,442	[6] 87,257,916	1.17	16,481.69	197,389	.12
North Carolina	73,330	8,207,000	5.60	89.06	19,040	.18
Oregon	4,577	357,041	3.90	248.95	4,104	1.65
Tennessee	759,995	16,374,261	1.08	522.93	75,556	.07
Texas	4,494	221,713	2.47	------------	2,118	.28
Utah	16,631,757	[7] 276,691,243	.83	115,164.28	1,275,682	.19
Washington	28,560	1,165,342	2.04	117.00	22,937	.56
Wyoming	29	2,604	4.49	------------	36	.72
Total and average	62,097,132	1,749,336,249	1.41	413,388.40	14,675,074	.28

[1] Excludes 11,509,594 pounds of copper from mine-water precipitates.
[2] Excludes 217 ounces of silver from mine-water precipitates.
[3] Excludes 206,160 pounds of copper from mine-water precipitates.
[4] Calculated only on ore that yielded silver.
[5] Excludes 6,701,580 pounds of copper from mine-water precipitates.
[6] Includes 387,042 pounds of copper recovered from leaching of a waste dump.
[7] Excludes 2,229,541 pounds of copper from mine-water precipitates and 3,978,236 pounds of copper from ore leached in place.

Copper produced in the United States, 1925–1927, from ores in which copper constitutes the principal value

State	1925		1926		1927	
	Copper ore (short tons)	Copper produced (pounds)	Copper ore (short tons)	Copper produced (pounds)	Copper ore (short tons)	Copper produced (pounds)
Alaska	860, 023	73, 849, 029	670, 000	[1] 67, 778, 000	645, 000	55, 343, 000
Arizona	20, 628, 410	[2] 709, 098, 985	22, 030, 481	[3] 718, 448, 062	[4] 21, 674, 826	[5, 6] 676, 549, 738
California	906, 644	44, 500, 353	831, 583	29, 698, 574	785, 366	24, 690, 901
Colorado	2, 193	286, 410	2, 126	315, 152	467	54, 313
Idaho	51, 004	2, 738, 861	28, 258	586, 387	27, 742	1, 030, 348
Michigan	7, 036, 751	155, 157, 488	7, 641, 682	175, 381, 565	8, 046, 334	177, 537, 775
Missouri	22	12, 100	50	44, 000	----------	----------
Montana	3, 130, 087	[2] 257, 629, 524	2, 825, 081	[3] 239, 039, 406	2, 929, 557	[6] 212, 995, 742
Nevada	3, 923, 158	[2] 78, 318, 519	4, 888, 681	[3] 100, 529, 055	4, 885, 052	[6] 118, 477, 899
New Mexico	3, 172, 291	76, 101, 442	3, 644, 936	81, 242, 662	3, 124, 447	[7] 71, 491, 246
North Carolina	----------	----------	15, 150	1, 468, 700	38, 400	5, 443, 115
Oregon	2, 740	105, 600	5, 632	293, 411	16, 214	486, 480
Tennessee	794, 930	19, 788, 234	608, 040	18, 606, 664	630, 955	14, 940, 595
Texas	----------	----------	61	9, 100	----------	----------
Utah	12, 575, 261	[2] 216, 124, 311	13, 949, 866	[3, 8] 239, 141, 740	13, 879, 173	[6, 9] 238, 232, 386
Vermont	----------	----------	14, 970	473, 200	4, 363	208, 224
Washington	19, 500	1, 158, 812	25, 297	1, 348, 545	37, 564	1, 684, 450
	53, 103, 014	1, 634, 869, 668	57, 181, 894	1, 674, 404, 223	56, 725, 460	1, 599, 166, 212

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[1] Includes a small quantity from lead ore.

[2] Excludes copper from mine-water precipitates, as follows: Arizona, 1,114,770 pounds; Montana, 4,804,364 pounds; Nevada, 476,540 pounds; Utah, 7,359,866 pounds.

[3] Excludes copper from mine-water precipitates, as follows: Arizona, 2,350,343 pounds; Montana, 5,044,108 pounds; Nevada, 341,843 pounds; Utah, 1,132,550 pounds.

[4] Includes 6,695 tons of old tailings.

[5] Includes copper from 6,695 tons of old tailings.

[6] Excludes copper from mine-water precipitates, as follows: Arizona, 4,412,437 pounds; Montana 4,515,407 pounds; Nevada, 189,554 pounds; Utah, 1,221,328 pounds.

[7] Includes 222,605 pounds of copper recovered from leaching of a waste dump.

[8] Excludes 5,054,499 pounds of copper from ore leached in place.

[9] Excludes 4,825,587 pounds of copper from ore leached in place.

Copper ores concentrated, leached, and smelted, and copper produced in the United States by each method in 1928

State	Ore concentrated			
	Short tons	Concentrates produced (short tons)	Copper produced (pounds)	Percentage of copper from ore
Alaska	568, 362	63, 194	28, 506, 231	2. 51
Arizona	15, 793, 494	889, 423	382, 361, 648	1. 21
California	748, 839	42, 781	21, 140, 805	1. 41
Idaho	30, 144	2, 475	938, 799	1. 56
Michigan	7, 361, 658	[1] 141, 703	[2] 178, 442, 704	1. 21
Montana	3, 064, 863	521, 972	229, 039, 043	3. 74
Nevada	6, 081, 808	360, 989	144. 351, 889	1. 19
New Mexico	3, 596, 144	130, 740	79, 205, 042	1. 10
North Carolina	12, 150	7, 900	1, 642, 000	6. 76
Oregon	2, 800	223	70, 300	1. 26
Tennessee	364, 494	34, 130	7, 461, 570	1. 02
Utah	16, 561, 500	446, 554	271, 951, 582	. 82
Washington	28, 229	1, 748	1, 083, 683	1. 92
Total and average	54, 214, 485	2, 643, 832	1, 346, 195, 296	1. 24

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[1] Includes concentrates from sands.

[2] Includes copper from sands.

Copper ores concentrated, leached, and smelted, and copper produced in the United States by each method in 1928—Continued

State	Ore leached			Ore smelted		
	Short tons	Copper produced (pounds)	Percentage of copper	Short tons	Copper produced (pounds)	Percentage of copper
Alaska	----------	----------	----------	11,138	12,914,769	57.98
Arizona	4,116,029	68,897,532	0.84	2,674,321	267,182,958	5.00
California	----------	----------	----------	151,952	3,610,394	1.19
Colorado	----------	----------	----------	11,983	1,299,636	5.42
Idaho	----------	----------	----------	1,310	120,145	4.59
Montana	----------	----------	----------	82,808	7,857,976	4.74
Nevada	250	7,527	1.51	161,989	12,387,073	3.82
New Mexico	(3)	(3)	(3)	137,298	8,052,874	2.93
North Carolina	----------	----------	----------	61,180	6,565,000	5.37
Oregon	----------	----------	----------	1,777	286,741	8.07
Tennessee	----------	----------	----------	395,501	8,912,691	1.13
Texas	----------	----------	----------	4,494	221,713	2.47
Utah	(4)	(4)	(4)	70,257	4,739,661	3.37
Washington	----------	----------	----------	331	81,659	12.34
Wyoming	----------	----------	----------	29	2,604	4.49
Total and average	4,116,279	68,905,059	.84	3,766,368	334,235,894	4.44

[3] Continued leaching of a waste dump yielded 387,042 pounds of copper.
[4] Ore leached in place yielded 3,978,236 pounds of copper; quantity of ore unknown.

Copper ores concentrated and smelted, and copper produced in the United States by each method, 1925–1927

State	Ore concentrated					
	1925		1926		1927	
	Short tons	Copper produced (pounds)	Short tons	Copper produced (pounds)	Short tons	Copper produced (pounds)
Alaska	840,625	45,785,584	649,750	[1] 43,182,739	629,736	37,959,263
Arizona	16,723,155	396,428,008	17,800,347	410,065,457	[2] 14,983,108	[3] 355,901,387
California	785,280	30,658,693	788,320	26,768,333	730,681	21,452,353
Idaho	48,235	2,416,822	26,799	455,636	26,562	910,599
Michigan	7,036,751	[4] 155,157,488	7,641,682	[4] 175,381,565	8,046,334	[4] 177,537,775
Montana	3,003,379	245,049,804	2,684,887	225,441,875	2,821,196	203,034,611
Nevada	3,844,631	72,611,578	4,756,591	93,428,646	4,755,216	109,193,609
New Mexico	[5] 3,002,700	[5] 66,973,638	3,523,319	74,035,200	2,982,137	64,461,564
Oregon	2,740	105,600	5,155	227,691	16,018	439,716
Tennessee	342,066	8,362,978	286,996	10,796,413	334,982	7,948,735
Utah	12,538,300	213,446,624	13,880,100	233,465,293	13,811,500	232,284,968
Vermont	----------	----------	14,970	473,200	4,363	208,224
Washington	18,907	1,047,074	24,868	1,220,990	37,202	1,598,437
	48,186,769	1,238,043,891	52,083,784	1,294,943,038	49,179,035	1,212,931,241

[1] Includes a small quantity from lead ore.
[2] Includes 6,695 tons of old tailings concentrated.
[3] Includes copper from 6,695 tons of old tailings concentrated.
[4] Includes copper from sands.
[5] A quantity of copper ore from New Mexico was leached, but this may not be shown separately and is included under ore concentrated.

Copper ores concentrated and smelted, and copper produced in the United States by each method, 1925–1927—Continued

State	Ore smelted					
	1925		1926		1927	
	Short tons	Copper produced (pounds)	Short tons	Copper produced (pounds)	Short tons	Copper produced (pounds)
Alaska	19, 398	28, 063, 445	20, 250	24, 595, 261	15, 264	17, 383, 737
Arizona	2, 865, 743	295, 380, 453	2, 899, 971	286, 923, 832	2, 552, 903	252, 671, 006
California	121, 364	13, 841, 660	43, 263	2, 930, 241	54, 685	3, 238, 548
Colorado	2, 193	286, 410	2, 126	315, 152	467	54, 313
Idaho	2, 769	322, 039	1, 459	130, 751	1, 180	119, 749
Missouri	22	12, 100	50	44, 000	----------	----------
Montana	126, 708	12, 579, 720	140, 194	13, 597, 531	108, 361	9, 961, 131
Nevada	78, 527	5, 706, 941	132, 090	7, 100, 409	129, 836	9, 284, 290
New Mexico	169, 591	9, 127, 804	121, 617	7, 207, 462	142, 310	6, 807, 077
North Carolina	----------	----------	15, 150	1, 468, 700	38, 400	5, 443, 115
Oregon	----------	----------	477	65, 720	196	46, 764
Tennessee	452, 864	11, 425, 256	321, 044	7, 810, 251	295, 973	6, 991, 860
Texas	----------	----------	61	9, 100	----------	----------
Utah	36, 961	2, 677, 687	69, 766	5, 676, 447	67, 673	5, 947, 418
Washington	593	111, 738	429	127, 555	362	86, 013
	3, 876, 733	379, 535, 253	3, 767, 947	358, 002, 412	3, 407, 610	318, 035. 021

Copper produced from copper-lead and copper-lead-zinc ores in the United States in 1928

State	Copper-lead and copper-lead-zinc ores (short tons)	Copper produced (pounds)	Percentage of copper
Arizona	22, 083	291, 798	0. 66
California	137	9, 167	3. 35
Colorado	366	23, 116	3. 16
Idaho	49, 322	177, 369	. 18
Montana	192, 839	804, 791	. 21
Nevada	40, 329	1, 835, 129	2. 28
Utah	45, 355	1, 193, 445	1. 32
Washington	700	11, 047	. 79
Total and average	351, 131	4, 345, 862	. 62

Copper produced from ores classed as copper-bearing (copper, copper-lead, and copper-lead-zinc ores) and total production of copper from all sources in the United States in 1928

State	From copper, copper-lead, and copper-lead-zinc ores			Copper from all sources, including old slags, smelter cleanings, and precipitates (pounds)
	Ore treated (short tons)	Copper produced (pounds)	Percentage of copper	
Alaska	579, 500	41, 421, 000	3. 57	41, 421, 000
Arizona [1]	22, 605, 927	718, 733, 936	1. 59	732, 276, 803
California	900, 928	24, 760, 366	1. 37	25, 150, 743
Colorado [2]	12, 349	1, 322, 752	5. 36	8, 594, 646
Idaho	80, 776	1, 236, 313	. 77	2, 072, 165
Michigan	7, 361, 658	178, 442, 704	1. 21	178, 442, 704
Missouri				65, 000
Montana [1]	3, 340, 510	237, 701, 810	3. 56	248, 262, 027
Nevada	6, 284, 376	158, 581, 618	1. 26	158, 876, 883
New Mexico	3, 733, 442	87, 257, 916	1. 17	89, 854, 646
North Carolina	73, 330	8, 207, 000	5, 60	8, 207, 000
Oregon	4, 577	357, 041	3, 90	358, 463
Pennsylvania				4, 977, 885
Tennessee	759, 995	16, 374, 261	1. 08	16, 374, 261
Texas	4, 494	221, 713	2. 47	447, 792
Utah [1]	16, 677, 112	277, 884, 688	. 83	293, 235, 039
Washington	29, 260	1, 176, 389	2. 01	1, 177, 246
Wyoming	29	2, 604	4. 49	2, 604
Total and average	62, 448, 263	1, 753, 682, 111	1. 40	1, 809, 796, 907

[1] Considerable copper was recovered from mine-water precipitates and from ores not classed as copper ores.

[2] Most of the copper from Colorado was derived in 1928 from ores classed as siliceous ores and lead-zinc ores.

Copper produced from ores classed as copper-bearing (copper, copper-lead, and copper-lead-zinc ores) and total production of copper from all sources in the United States, 1925–1927

State	1925			1926			1927		
	From copper, copper-lead, and copper-lead-zinc ores		Copper from all sources, including old slags, smelter cleanings, and precipitates	From copper, copper-lead, and copper-lead-zinc ores		Copper from all sources, including old slags, smelter cleanings, and precipitates	From copper, copper-lead, and copper-lead-zinc ores		Copper from all sources, including old slags, smelter cleanings, and precipitates
	Ore treated	Copper produced		Ore treated	Copper produced		Ore treated	Copper produced	
	Short tons	*Pounds*	*Pounds*	*Short tons*	*Pounds*	*Pounds*	*Short tons*	*Pounds*	*Pounds*
Alaska	860, 023	73, 849, 029	73, 855, 298	670, 000	[1] 67, 778, 000	67, 778, 000	645, 000	55, 343, 000	55, 343, 000
Arizona [2]	20, 652, 975	709, 932, 148	713, 355, 129	22, 055, 501	719, 424, 088	723, 296, 051	21, 686, 756	676, 729, 022	682, 190, 547
California	906, 644	44, 500, 353	46, 864, 913	831, 966	29, 720, 699	33, 466, 299	785, 559	24, 704, 287	27, 133, 008
Colorado	3, 610	363, 910	2, 360, 500	2, 223	323, 277	3, 403, 850	877	62, 597	5, 670, 581
Idaho	57, 279	2, 829, 338	3, 297, 443	50, 295	702, 511	1, 337, 442	67, 867	1, 294, 747	2, 173, 163
Michigan	7, 036, 751	155, 157, 488	155, 157, 488	7, 641, 682	175, 381, 565	175, 381, 565	8, 046, 334	177, 537, 775	177, 537, 775
Missouri	22	12, 100	12, 100	50	44, 000	1, 077, 000	----------	----------	451, 000
Montana [2]	3, 325, 414	259, 012, 065	268, 910, 847	3, 049, 403	240, 689, 583	255, 372, 862	3, 193, 425	214, 568, 948	223, 492, 639
Nevada	3, 923, 283	78, 329, 945	79, 300, 224	4, 898, 832	101, 123, 855	101, 827, 937	4, 910, 356	119, 801, 203	120, 259, 276
New Mexico	3, 172, 618	76, 142, 942	76, 427, 825	3, 644, 941	81, 242, 912	81, 642, 379	3, 127, 340	71, 641, 954	74, 251, 863
North Carolina	----------	----------	----------	15, 150	1, 468, 700	1, 468, 700	38, 400	5, 443, 115	5, 443, 115
Oregon	2, 740	105, 600	106, 325	5, 632	293, 411	296, 454	16, 214	486, 480	488, 200
Pennsylvania	----------	----------	1, 035, 824	----------	----------	1, 018, 536	----------	----------	1, 735, 800
Tennessee	794, 930	19, 788, 234	19, 788, 234	608, 040	18, 606, 664	18, 606, 664	630, 955	14, 940, 595	14, 940, 595
Texas	----------	----------	----------	61	9, 100	12, 620	----------	----------	21, 458
Utah [2]	12, 575, 837	216, 135, 875	236, 486, 540	13, 949, 866	239, 141, 740	257, 464, 482	13, 953, 051	240, 451, 102	256, 933, 278
Vermont	----------	----------	----------	14, 970	473, 200	473, 200	4, 363	208, 224	208, 224
Washington	19, 500	1, 158, 812	1, 159, 057	25, 297	1, 348, 545	1, 351, 890	37, 564	1, 684, 450	1, 685, 848
	53, 331, 626	1, 637, 317, 839	1, 678, 117, 747	57, 463, 909	1, 677, 771, 850	1, 725, 275, 931	57, 144, 061	1, 604, 897, 499	1, 649, 959, 370

[1] Includes a small quantity of copper from lead ore.

[2] Considerable copper was recovered from mine-water precipitates and from ores not classed as copper ores.

Copper ores produced in the United States, 1919–1928, and average yield in copper, gold, and silver

Year	Smelting ores		Concentrating ores		Total				
	Short tons	Yield in copper (per cent)	Short tons	Yield in copper (per cent)	Short tons	Yield in copper (per cent)	Yield per ton in gold (ounce)	Yield per ton in silver (ounce)	Value per ton in gold and silver
1919	3,465,880	4.64	30,769,966	1.35	36,121,622	1.65	0.0052	0.356	$0.51
1920	3,200,509	4.89	31,348,340	1.34	36,765,370	1.63	.0047	.331	.46
1921	1,235,602	4.77	11,022,544	1.44	13,396,382	1.70	.0039	.357	.44
1922	2,278,047	5.36	23,258,970	1.43	26,893,247	1.74	.0049	.386	.49
1923	3,496,728	5.12	40,209,754	1.29	45,519,317	1.58	.0060	.321	.39
1924	3,554,915	5.08	44,427,264	1.33	49,178,315	1.59	.0063	.325	.35
1925	3,876,733	4.90	48,186,769	1.28	53,103,014	1.54	.0065	.338	.37
1926	3,767,947	4.75	52,083,784	1.24	57,181,894	1.46	.0064	.293	.31
1927	3,407,610	4.67	49,179,035	1.23	56,725,460	1.41	.0065	.255	.28
1928	3,766,368	4.44	54,214,485	1.24	62,097,132	1.41	.0067	.236	.28

REVIEW BY STATES AND COMPANIES

SCOPE OF DISCUSSION

This section summarizes the conditions affecting production in the principal copper districts of the country. The tenor of the ore from each district is given, so far as it does not disclose the production of those individual companies whose figures of output have not already been published in their annual reports or elsewhere. More detailed information on the mining operations of the districts is given in the chapters on mine production.

In this report the individual companies' figures for metal output, ore reserves, metal content, and recovery in treatment, unless otherwise stated, are quoted from the published official reports of the companies. The chapter on copper in Mineral Resources for 1915 contains a map showing the location of the copper-producing districts and the metallurgical plants and also a brief discussion of the geologic occurrence of the ores in the several districts.

In 1929 the American Smelting & Refining Co. had available for dividends, after deducting all charges, taxes, bond interest, depreciation, and depletion, a net income of $21,831,583, compared with $18,586,204 in 1928. During the year the company expended, without additional financing, $10,323,760 for new undertakings and betterments, and $800,600 for retirement of bonds. Statistics on the company's operations for several years are given in the following table.

Operations of the American Smelting & Refining Co., 1925–1929

	1925	1926	1927	1928	1929
PRODUCTION					
Gold ounces	1,667,849	1,634,158	1,479,899	1,407,286	1,461,215
Silver do	82,223,189	85,482,438	80,671,759	81,434,214	89,098,293
Lead short tons	455,261	469,607	476,988	471,880	545,100
Copper do	502,831	525,897	536,830	563,713	619,398
Zinc do	45,246	48,723	52,170	47,433	54,510
OPERATING STATISTICS					
Number of men employed	26,401	28,612	27,363	26,757	30,253
Charge smelted short tons	5,638,730	5,433,547	4,643,306	4,330,508	4,620,185
Bullion refined do	936,346	990,295	1,004,196	1,038,030	1,151,605
Coal used do	390,981	413,351	413,366	416,351	415,745
Coke used do	517,401	508,033	492,171	386,478	401,435
Fuel oil used barrels	2,268,267	1,836,923	1,627,258	1,706,651	1,765,408
Gas used cubic feet	5,432,356,000	6,223,869,000	6,402,907,000	5,158,775,000	5,562,375,000
Ore mined short tons	1,656,212	1,875,991	2,234,880	2,482,998	2,493,569
Coal mined do	433,440	749,646	810,329	738,483	809,844
Coke produced do	323,384	360,270	366,909	340,893	369,636

ALASKA

The output of blister copper from Alaska ores was 39,867,940 pounds in 1929, a decrease from 40,541,968 pounds in 1928. The 1929 production raised Alaska's total recorded production to 1,157,595,157 pounds, 2.69 per cent of the country's total from 1845 to 1929. Alaska remained in seventh place in 1929 among the copper-producing States. In smelter production for 1929 Alaska continued to rank seventh also, with 1.99 per cent of the total production of the country.

Prince William Sound.—The Beatson mine of the Kennecott Copper Corporation produced 452,962 tons of ore, having an average copper content of 1.28 per cent and 0.243 ounce of silver per ton. The mill treated the entire tonnage, yielding 33,091 tons of concentrates, with a copper content of 14.47 per cent—a recovery of 82.64 per cent. In 1928 the production amounted to 442,765 tons of ore, averaging 1.26 per cent of copper; it yielded 30,216 tons of concentrates, averaging 15.38 per cent of copper—a recovery of 83.28 per cent.

Copper River district.—At Kennecott 79,955 tons of ore was produced, containing an average of 11.86 per cent of copper and 2.25 ounces of silver per ton. Of this quantity 76,272 tons was treated at the mill at Kennecott and yielded 16,373 tons of concentrates, with an average content of 40.87 per cent of copper—a recovery of 95.23 per cent. In 1928, 74,688 tons of ore, containing an average of 12.50 per cent of copper, was mined at Kennecott.

At the property of the Mother Lode Coalition Mines Co., 57,177 tons of ore was produced, containing an average of 11.14 per cent of copper and 1.85 ounces of silver per ton. Shipments to the smelter totaled 13,639 tons, containing 12,242,740 pounds of copper and 97,867 ounces of silver.

ARIZONA

Arizona is the most important copper-producing State, both in production for 1929 and in total production for the country from 1845 through 1929. In 1929 Arizona produced 829,206,475 pounds of copper, 41.40 per cent of the total for the United States; Montana, the nearest competitor in total production through 1929, produced 14.97 per cent of the country's total in 1929. Arizona's total production through 1929 is 13,914,970,235 pounds, 32.32 per cent of the total United States production; Montana has produced 23.24 per cent of the United States total and Michigan 19.14 per cent. Arizona came into the lead in total production in 1920. In 1919 Montana stood first, with 27.59 per cent of the total production, and Arizona was a close second, with 27.45 per cent. Among the six most important States in the output of copper, Arizona is the only one whose production is not made almost entirely from one district.

Bisbee district.—The Bisbee district produced more copper during the period from 1845 through 1929 than any other district in Arizona, but from 1916 through 1927 and again in 1929 the Globe-Miami district had a considerably larger annual production. In 1928 and 1929 the Jerome district ranked first in Arizona. The Bisbee district was second in 1928 and third in 1929. Among the country's copper-producing districts leading in total production, Bisbee, with a total recorded production through 1929 of 3,942,042,000 pounds of copper, ranks next to the Butte and Lake Superior districts. Bisbee ranked sixth in production for 1929, with 186,130,000 pounds of copper.

Copper produced in Bisbee district, Arizona, 1920–1929, in pounds

1920	118, 448, 000	1925	145, 433, 000
1921	37, 249, 000	1926	140, 668, 000
1922	79, 591, 000	1927	138, 595, 000
1923	123, 884, 000	1928	161, 492, 000
1924	140, 630, 000	1929	186, 130, 000

The Phelps Dodge Corporation, its branches and subsidiaries, produced ores in 1929 that yielded the following metals: Copper, 218,360,613 pounds; lead, 2,071,047 pounds; silver, 1,207,097 ounces; gold, 38,249 ounces; and manganese, 2,325,857 pounds. Its purchased ores yielded 3,642,750 pounds of copper, 10,687,706 pounds of lead, 2,577,130 ounces of silver, and 12,823 ounces of gold.

At the Copper Queen branch copper production from the limestone mines increased somewhat from the 1928 figures largely because of increased lease outputs. Development work amounted to 40,784 feet, compared with 33,830 feet in 1928. The Southwest division practically became exhausted in 1928 but some ore was mined in 1929. Production from the Czar and Holbrook mines will replace that of the Southwest division, but the grade of the ore will probably be lower in the future. Caving operations in the Southeast extension produced 422,616 tons of ore in 1929 and yielded 17,201,165 pounds of copper, compared with 12,414,089 pounds of copper in 1928. Sacramento Hill (West ore body) produced 1,095,612 tons of ore from shovel and gloryhole mining; 994,979 tons of this total was milling ore and 100,633 tons was smelting ore. In addition 70,286 tons of leaching ore was mined. The milling and smelting ore yielded 53,107,420 pounds of copper, 150,847 ounces of silver, and 7,726 ounces of gold. These figures indicate a decrease in ore output and a general decrease in metals obtained. The copper department of the concentrator milled 1,445,425 dry tons of ore, with an average grade of 2.15 per cent of copper, a marked gain in tonnage and an increase of 0.05 point in average grade. Because of the higher grade of the ore treated during 1929 it was necessary to drop further the ratio of concentration, from 7.93 into 1 in 1928 to 6.58 into 1 in 1929. The recovery of total copper was 91.32 per cent, compared with 91.26 per cent in 1928. Total shipments from the Don Luis precipitation plant to the smelter contained more than 12,288,871 pounds of gross copper; leaching operations still continued good, and the apparent recovery from the precipitation plant was 97.24 per cent. A small plant near the Holbrook shaft was put in operation in 1928 for the treatment of the acid Czar mine water and enriched liquors from underground leaching in the Holbrook division; in 1929, 1,020,543 pounds of copper was produced, with a recovery of 94.71 per cent. The reduction plant at Douglas produced 166,790,836 pounds of copper, 1,474,020 ounces of silver, and 37,384 ounces of gold from 968,655 tons of material smelted.

Metals produced by Copper Queen branch of Phelps Dodge Corporation, 1920–1929

Year	Ore	Copper	Silver	Gold	Lead	Zinc
	Short tons	*Pounds*	*Ounces*	*Ounces*	*Pounds*	*Pounds*
1920	832, 172	71, 443, 396	486, 698	8, 846	243, 836	----------
1921	515, 632	30, 610, 173	495, 179	4, 650	4, 916, 418	----------
1922	389, 367	47, 962, 123	1, 132, 304	11, 972	8, 560, 525	247, 793
1923	1, 189, 570	87, 935, 334	935, 729	19, 151	6, 307, 412	610, 709
1924	2, 022, 196	109, 117, 018	906, 521	29, 850	6, 094, 613	----------
1925	1, 940, 737	116, 379, 978	1, 079, 733	32, 007	7, 103, 853	----------
1926	1, 921, 021	109, 269, 035	907, 292	35, 382	3, 868, 259	----------
1927	1, 838, 665	106, 351, 930	781, 989	32, 651	4, 031, 433	----------
1928	1, 785, 739	115, 570, 399	684, 006	32, 711	4, 277, 156	----------
1929	2, 058, 231	127, 605, 697	625, 795	34, 149	2, 259, 967	----------

Metals produced by Copper Queen branch of Phelps Dodge Corporation in 1929

	Ore, dry weight	Gold	Silver	Copper	Lead	Manganese
Underground limestone:						
Copper—	*Short tons*	*Ounces*	*Ounces*	*Pounds*	*Pounds*	*Pounds*
Limestone	354, 355	11, 439	266, 638	31, 536, 661	----------	----------
Lease	105, 727	11, 692	130, 076	11, 022, 426	----------	----------
	460, 082	23, 131	396, 714	42, 559, 087	----------	----------
Lead—						
Company	9, 005	596	18, 832	62, 649	1, 902, 942	----------
Lease	6, 956	107	8, 706	374, 268	357, 025	----------
	15, 961	703	27, 538	436, 917	2, 259, 967	----------
Manganese—						
Lease	2, 853	----------	----------	----------	----------	2, 325, 857
West ore body:						
Glory hole—						
Smelting	35, 174	214	7, 970	1, 830, 043	----------	----------
Milling	306, 535	6, 037	44, 525	16, 585, 972	----------	----------
	341, 709	6, 251	52, 495	18, 416, 015	----------	----------
Sacramento Hill—						
Smelting	65, 459	656	15, 739	6, 465, 185	----------	----------
Milling	688, 444	819	82, 613	28, 226, 220	----------	----------
	753, 903	1, 475	98, 352	34, 691, 405	----------	----------
East ore body:						
S. E. extension—						
Smelting	24, 167	78	2, 250	1, 130, 871	----------	----------
Milling	398, 449	2, 306	44, 046	16, 070, 294	----------	----------
	422, 616	2, 384	46, 296	17, 201, 165	----------	----------
North block—						
Smelting	68	1	12	5, 477	----------	----------
Milling	51, 286	204	4, 214	1, 271, 448	----------	----------
	51, 354	205	4, 226	1, 276, 925	----------	----------
Precipitates:						
S. H. company	9, 008	----------	156	12, 136, 062	----------	----------
S. H. lease	71	----------	----------	59, 869	----------	----------
Holbrook	674	----------	18	828, 252	----------	----------
	9, 753	----------	174	13, 024, 183	----------	----------
	2, 058, 231	34, 149	625, 795	127, 605, 697	2, 259, 967	2, 325, 857

The Calumet & Arizona Mining Co. produced from ores and concentrates from all sources 130,486,607 pounds of copper in 1929, compared with 122,319,580 pounds in 1928. The sulphuric acid plant was operated throughout the year, producing more than 71,000 tons of 60° Baumé acid. The company did 62,939 feet of development work compared with 63,003 feet in 1928. Increased ore reserves in the Campbell ore body were reported from the 1,500 level to the 2,200 level, and new bodies of ore have been discovered in the Junction area. The mines at Bisbee produced 597,497 wet tons of ore averaging 5.11 per cent of copper compared with 5 per cent during 1928.

Metals [1] produced by Calumet & Arizona Mining Co., 1920–1929

Year	Refined copper produced	Gold	Silver	Dividends
	Pounds	*Ounces*	*Ounces*	
1920	42, 430, 847	32, 520	932, 489	$2, 570, 084
1921	17, 855, 613	12, 365	419, 647	1, 285, 043
1922	30, 830, 615	23, 349	642, 174	1, 285, 047
1923	42, 166, 930	35, 693	824, 768	2, 248, 849
1924	41, 582, 030	31, 934	813, 791	1, 285, 063
1925	44, 557, 219	37, 287	832, 434	2, 571, 028
1926	45, 553, 208	35, 554	972, 650	3, 856, 542
1927	48, 164, 083	33, 556	1, 015, 450	3, 856, 542
1928	51, 732, 822	37, 605	1, 248, 700	4, 499, 299
1929 [2]	127, 139, 117	54, 672	1, 688, 376	8, 185, 563

[1] Exclusive of metals produced from purchased ores.
[2] Includes operations of New Cornelia Copper Co., Ajo district, which was consolidated with Calumet & Arizona Mining Co. in 1929 (see p. 557).

The Shattuck Denn Mining Corporation reported the development of new ore in the 2,100 and 2,200 foot levels of the Denn mine. Some new ore was also encountered in the Ophir claim. The following table shows the result of the company's operations during 1929.

Metallic production of the Shattuck Denn Mining Corporation in 1929

Shattuck mine:		
From copper ores—		
Copper	pounds	2, 003, 690
Gold	ounces	2. 62
Silver	do	32
From lead ores—		
Lead	pounds	28, 760
Copper	do	2, 409
Gold	ounces	8. 86
Silver	do	1, 498
Denn mine:		
From copper ores—		
Copper	pounds	10, 730, 051
Gold	ounces	5, 512. 94
Silver	do	241, 391

Metals produced by Shattuck Denn Mining Corporation, 1920–1929

[Shattuck Arizona Copper Co. prior to 1925]

Year	Copper (from copper ores)	Silver (from copper ores)	Gold (from copper ores)	Lead recovered	Copper recovered
	Pounds	*Ounces*	*Ounces*	*Pounds*	*Per cent*
1920	2, 374, 148	73, 718	575	8, 254, 603	6. 19
1921 [1]	287, 928	12, 093	29		7. 94
1922					
1923	3, 223, 209	157, 124	1, 349	1, 590, 682	6. 42
1924	2, 630, 185	72, 671	754	5, 244, 526	6. 44
1925	1, 828, 699	34, 246	633	3, 757, 811	5. 52
1926	3, 045, 518	46, 905	960	5, 798, 362	6. 56
1927	4, 145, 711	36, 359	719	5, 011, 837	6. 88
1928	4, 936, 831	55, 141	810	1, 548, 363	5. 56
1929	12, 733, 741	241, 423	5, 516	28, 760	(2)

[1] Result of development work only. No productive operations carried on.
[2] Figures not available.

Globe-Miami district.—The Globe-Miami district was formerly the most important copper-producing district in Arizona; it ranks second in Arizona to the Bisbee district in total production for the period from 1845 through 1929, with a total recorded output of 3,131,069,000 pounds. In total output the Globe-Miami ranks fifth among the copper-producing districts of the country, and in output for 1929 it ranks fourth. The district produced 191,596,000 pounds of copper in 1929 compared with 160,430,000 in 1928.

Copper produced in Globe-Miami district, Arizona, 1920–1929, in pounds

1920	176, 215, 000	1925	175, 272, 000
1921	76, 488, 000	1926	175, 386, 000
1922	170, 035, 000	1927	171, 167, 000
1923	198, 426, 000	1928	160, 430, 000
1924	190, 452, 000	1929	191, 596, 000

The Old Dominion Co. mined 415,891 tons of ore in 1929, compared with 353,392 tons in 1928. The grade was 2.65 per cent copper in 1929 and 2.92 per cent in 1928. The refined copper produced in 1929 aggregated 18,943,000 pounds, compared with 17,717,267 pounds in 1928. The concentrating ore mined during the year came largely from the 1,600 and 2,200 foot levels, east; from the new ore body on the 2,200 and 2,400 levels, west; and from the Maggie vein. The smelting ore came from the lower levels on the west side. Development work amounted to 32,758 feet; the new ore discovered was of a lower grade than that in 1928, thus reducing the tenor of the reserves from 2.99 per cent of copper in 1928 to 2.37 per cent in 1929. The company reported an increase of 483,948 tons of new ore in reserve tonnage for the year, in addition to which it included as reserves 179,246 tons of material that had not been previously available, but which can now (March, 1930) be mined at a profit—a total increase of 665,000 tons of ore, or 18,000,000 pounds of recoverable copper. Development work on the twenty-third and twenty-fourth levels disclosed the large body of concentrating ore which has materially increased reserves in both tonnage and copper content. The development campaign for 1930 will be centered on the 2,400, 2,500, and 2,600 foot levels.

The following results were obtained at the concentrator:

	1928	1929
Copper assay of heads...per cent	2. 97	2. 61
Copper assay of concentrates...do	21. 48	18. 97
Copper assay of tails...do	. 27	. 279
Extraction...do	90. 0	89. 9
Ratio of concentration	8. 04 to 1	8. 10 to 1

Metals produced by Old Dominion Co., 1920–1929 [1]

Year	Ore	Refined copper	Gold	Silver	Average grade of ore in copper
	Short tons	*Pounds*	*Ounces*	*Ounces*	*Per cent*
1920	249, 111	22, 854, 452	3, 484	181, 010	4. 79
1921	61, 753	7, 389, 648	1, 187	71, 155	5. 31
1922	202, 954	18, 573, 289	3, 317	122, 095	5. 14
1923	289, 695	26, 764, 801	5, 137	190, 033	4. 95
1924	294, 999	25, 400, 670	5, 531	155, 814	4. 62
1925	355, 623	27, 283, 655	5, 752	150, 782	4. 16
1926	362, 213	25, 425, 833	7, 040	149, 235	3. 94
1927	356, 697	21, 570, 615	(2)	(2)	3. 42
1928	353, 392	17, 717, 267	(2)	(2)	2. 92
1929	415, 891	18, 943, 000	(2)	(2)	2. 65

[1] Includes custom metals produced.

[2] Not given.

The Miami Copper Co.'s mill treated 5,017,983 tons of ore (an average of 14,056 tons per day), compared with 4,260,599 tons in 1928. The ore averaged 0.83 per cent in 1929 and 0.853 per cent in 1928. The concentrates obtained in 1929 averaged 36.241 per cent of copper, compared with an average of 38.36 per cent in 1928. The ratio of concentration in 1929 was 60 to 1. Underground development work amounted to 96,455 feet, compared with 84,619 feet in 1928. From the concentrates 58,841,159 pounds of refined copper were obtained in 1929, compared with 48,259,448 pounds in 1928. The cost of producing copper during the year was 11.741 cents per pound, and the average sales price was 18.10 cents. On January 1, 1930, the ore reserves were as follows:

Ore reserves of Miami Copper Co., January 1, 1930

	Short tons	Per cent copper	
		Total	Soluble
Sulphide ore	90, 391, 980	0. 88	0. 09
Mixed ore	7, 000, 000	1. 83	1. 34

Copper produced by Miami Copper Co., 1920–1929

Year	Ore	Copper content	Mill extraction	Refined copper	Dividends
	Short tons	*Per cent*	*Per cent*	*Pounds*	
1920	1, 801, 958	1. 968	82. 48	55, 581, 328	$1, 494, 228
1921	1, 868, 757	1. 758	85. 37	53, 311, 941	1, 494, 228
1922	2, 183, 020	1. 883	86. 36	67, 454, 447	1, 494, 228
1923	2, 380, 155	1. 697	83. 98	64, 448, 345	1, 494, 228
1924	2, 444, 079	1. 624	80. 17	60, 475, 547	1, 494, 228
1925	2, 919, 600	1. 287	72. 60	51, 851, 274	933, 893
1926	3, 793, 207	. 979	76. 77	55, 289, 174	840, 505
1927	4, 116, 255	. 855	77. 64	53, 038, 218	1, 120, 674
1928	4, 260, 599	. 853	68. 41	48, 259, 448	1, 120, 674
1929	5, 017, 983	. 830	72. 80	58, 841, 159	2, 614, 906

Milling operations of Miami Copper Co. in 1929

Ore milled	short tons	5, 017, 983
Copper in ore	per cent	0. 830
Concentrates produced	short tons	83, 691
Copper in concentrates	per cent	36. 241
	pounds	60, 660, 984
Copper recovered per ton of ore	do	12. 09
Mill extraction	per cent	72. 80

Cost of copper in concentrates f. o. b. cars at Miami, Ariz., in 1929

	Per ton of ore	Per pound of copper
Mining	$0. 42308	$0. 03608
Milling	. 35913	. 03062
General	. 15218	. 01298
	. 93439	. 07968

During 1929 the Inspiration Consolidated Copper Co. mined 5,799,587 tons of ore, as follows:

Ore mined by the Inspiration Consolidated Copper Co. in 1929

	Short tons	Per cent copper
Concentrating and smelting ores	2, 560, 147	1. 114
Leaching ores	3, 239, 440	1. 188
	5, 799, 587	1. 155

Copper produced by the Inspiration Consolidated Copper Co. in 1929

	Ore treated (tons)	Copper produced (pounds)
Inspiration concentrating ore	457, 468	5, 583, 903
Live Oak concentrating ore	1, 942, 182	34, 821, 439
Keystone concentrating ore	117, 723	1, 901, 902
Southwestern Miami concentrating ore	42, 529	646, 161
Live Oak ore to smelter	245	3, 748
Inspiration leaching ore	353, 067	7, 871, 222
Live Oak leaching ore	1, 270, 338	26, 672, 820
Keystone leaching ore	1, 455, 698	28, 814, 200
Inspiration leaching ore slimes	15, 435	100, 294
Live Oak leaching ore slimes	55, 535	339, 861
Keystone leaching ore slimes	63, 638	367, 150
Leached from mine waste	------------	184, 367
	5, 773, 858	107, 307, 067
Plus net production from soluble anode inventory and adjustments	------------	209, 134
Net production available for sales	------------	107, 516, 201

During the year 2,559,902 tons of ore averaging 1.114 per cent copper was milled, producing concentrates that averaged 35.67 per cent copper. The recovery of copper was 78.28 per cent and the recovery of sulphide copper in the ore was 95.06 per cent. The sulphide ore produced was mined at the rate of 9.223 tons per man-shift, and the ores shipped to the leaching plant were mined at the rate of 13.789 tons per man-shift. The total development work carried on underground consisted of 135,890 feet of workings and 7,885 cubic yards of miscellaneous excavation, together with 7,988 feet of diamond drilling, 400 feet of churn drilling, and 439 feet of shaft sinking. During the year 3,052,268 tons of ore were charged into the leaching tanks, an average of 8,720.9 tons (dry) per charge. The average extraction of total copper amounted to 89.117 per cent. The cost of copper, excluding depletion and Federal taxes, was given in the company's annual statement as 11.1328 cents per pound. The production of copper was 107,307,067 pounds, obtained from 5,773,858 dry tons of ore.

Mill statistics, Inspiration Consolidated Copper Co., in 1929

Total ore milled	dry tons	2, 559, 902
Ore milled per day	do	7, 251. 8
Average number of sections running		7. 667
Average rate per section	tons	945. 8
Screen analysis of feed (on 48 mesh)	per cent	2. 1
Assay mill feed	per cent of copper	1. 114
Copper in feed, oxidized	per cent	. 245
Copper assay of general tailings	do	. 248
Copper in general tailings, oxidized	do	. 204
Copper in general concentrates, smelter assay	do	35. 667
Copper in flotation concentrates	do	39. 24
Copper in table concentrates	do	4. 46
Moisture in general concentrates	do	10. 14

Ratio of concentration		41. 26
Recovery of copper	per cent	78. 28
Recovery of copper sulphides	do	95. 06
Water used per ton of ore	tons	. 95
Power used per ton of ore milled:		
Coarse crushing	kilowatt-hours	. 45
Fine grinding and concentrating	do	8. 67
Blowers for flotation air	do	2. 06
Filtering and reclaiming water	do	1. 00
Lighting	do	. 19
		12. 37
Steel balls consumed in fine grinding per ton of ore milled	pounds	1. 42
Flotation material used per ton of ore milled:		
Lime	do	1. 071
Sodium and potassium xanthate	do	. 042
Sundry oils	do	. 120
Sodium sulphide	do	. 169
		1. 402

The Iron Cap Copper Co. did not operate its mine near Globe in 1929, but milled 78,048 tons and shipped 51,056 tons of smelting ore. Total copper produced and sold from the mine at Christmas amounted to 4,417,770 pounds. The new mill at Christmas was completed in June, 1929, and operated during the remainder of the year. The mill heads averaged 1.974 per cent copper and an extraction of 87.57 per cent was made. A new ore body was disclosed on the 800-foot level, after unwatering the shaft, proving the presence of ore zones below the 500-foot level. The Iron Cap Co. controls 75 per cent of the stock in the Christmas Copper Co. property.

The Arizona Commercial Mining Co. produced 62,085 tons of ore averaging 3.57 per cent of copper in 1929, compared with 60,948 tons averaging 4.48 per cent in 1928. From the ore in 1929 were obtained 3,800,456 pounds of copper, 21,010 ounces of silver, and 596 ounces of gold. The company did 1,291 feet of development work, compared with 3,114 feet in 1928, but development work in recent years has disclosed little new ore. Diamond drilling below the 2,200-foot level indicated some ore containing approximately 1¼ per cent of copper, but, partly because of unusually difficult drilling conditions, no definite grade or tonnage of ore or near ore could be calculated. The lack of promise below the 2,200-foot level has caused the company to search for other property to develop.

Copper, gold, and silver produced by the Arizona Commercial Mining Co., 1920–1929

Year	Refined copper	Gold	Silver	Year	Refined copper	Gold	Silver
	Pounds	*Ounces*	*Ounces*		*Pounds*	*Ounces*	*Ounces*
1920	7, 913, 836	1, 722	31, 028	1925	7, 860, 866	1, 972	39, 430
1921	572, 616	163	3, 001	1926	5, 985, 607	1, 444	34, 614
1922	6, 220, 923	1, 585	27, 532	1927	5, 505, 448	1, 157	32, 664
1923	8, 115, 212	2, 143	37, 826	1928	4, 665, 605	793	29, 074
1924	7, 760, 931	1, 883	32, 634	1929	3, 800, 456	596	21, 010

Morenci-Metcalf district.—The copper production of the Morenci-Metcalf district amounted to 56,781,000 pounds, compared with 54,-

053,000 pounds in 1928. In total output through 1929 the district ranks seventh among the copper-producing districts of the United States.

Copper produced in Morenci-Metcalf district, Arizona, 1920–1929, in pounds

1920	35, 746, 000	1925	59, 464, 000
1921	11, 420, 000	1926	63, 950, 000
1922	14, 175, 900	1927	59, 760, 000
1923	28, 735, 000	1928	54, 053, 000
1924	41, 047, 000	1929	56, 781, 000

The Morenci branch of the Phelps Dodge Corporation mined 1,738,084 dry tons of ore, of which 30,683 tons were lease ore. The total development work, excluding diamond drilling but including drift, winzes, raises, drill, and stope developments, amounted to 39,716 feet. The concentrator treated 1,711,449 tons of ore and produced 115,331 dry tons of concentrates. The average grade of the ore was lower but recovery was slightly higher. The mill changes which were begun in 1928 were nearly completed in 1929. The Clifton smelter treated 143,604 tons of new metal-bearing material during the year and produced 55,265,349 pounds of copper in bullion.

Yavapai County.—The output of copper in Yavapai County, mostly from the Jerome district, in 1929 and in several preceding years is given in the table that follows. From the beginning of operations through 1929 Jerome ranks sixth among the country's copper-producing districts. The chief producers of the district are the United Verde Copper Co. and the United Verde Extension Mining Co.

Copper produced in Yavapai County, Ariz., 1920–1929, in pounds

1920	114, 937, 080	1925	154, 017, 340
1921	26, 576, 298	1926	155, 368, 000
1922	76, 607, 502	1927	141, 642, 000
1923	147, 718, 492	1928	165, 297, 000
1924	143, 348, 230	1929	208, 172, 000

During 1929 the United Verde Extension Mining Co. produced 358,654 tons of ore from its mine, averaging 8.49 per cent of copper, 1.59 ounces of silver, and 0.038 ounce of gold. Of this ore, 326,203 tons were shipped to the smelter; the average yield was 8.66 per cent of copper, 1.64 ounces of silver, and 0.039 ounce of gold. The copper produced at Clemenceau amounted to 59,177,082 pounds. The company also shipped silica ore yielding 4,934,849 pounds of copper. It completed 18,079 feet of raises and drifts but did no diamond drilling. At the end of 1929 the reserves amounted to 625,000 tons of ore averaging about 7½ per cent of copper. The cost was 8.46 cents per pound, exclusive of depreciation, taxes, and reserve to return capital (depletion). The company distributed dividends amounting to $3,937,500, or $3.75 per share.

Cost[6] of producing copper by United Verde Extension Mining Co. in 1929

	Cents per pound
Mining	2. 47
Smelting	2. 33
Freight on ore	. 08
Freight on bullion, refining, selling	1. 72
Custom ore purchased	1. 19
Other expenses	. 67
	8.46

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[6] Exclusive of depreciation, reserve to return capital (depletion), and taxes.

Copper produced by the United Verde Extension Mining Co., 1920–1929

Year	Ore treated	Copper produced	Silver	Gold
	Short tons	*Pounds*	*Ounces*	*Ounces*
1920	161,617	41,942,700	359,370	5,530
1921	53,643	12,498,005	112,864	2,328
1922	136,980	31,640,714	238,764	5,788
1923	172,629	41,855,959	257,602	8,992
1924	185,858	44,278,947	(1)	(1)
1925	[2] 183,309	[3] 43,720,324	(1)	(1)
1926	198,911	43,041,576	(1)	(1)
1927	[2] 248,799	[3] 41,301,930	(1)	(1)
1928	[2] 246,477	[3] 45,200,041	(1)	(1)
1929	[2] 343,115	[3] 64,111,931	(1)	(1)

[1] Figures not available.
[2] Includes custom ore and concentrates smelted.
[3] Includes copper from custom ore and concentrates smelted.

The Verde Central Mines (Inc.) completed a new concentrator in January, 1929, and thereafter treated 93,050 tons of ore averaging 2.70 per cent of copper and produced concentrates averaging 21.34 per cent of copper—a recovery of 92.1 per cent. The concentrates yielded 4,335,261 pounds of copper and 19,796 ounces of silver. No new ore was found after 1,487 feet of development work, but several stopes showed larger widths and lengths than were anticipated.

The mines and plants of the United Verde Copper Co. were active continuously throughout 1929.

Ray or Mineral Creek district.—In 1929 the Ray district produced 66,287,000 pounds of copper. The total recorded output of the district through 1929 is 1,085,080,000 pounds; it continued to rank tenth among the copper-producing districts of the country.

At the Ray mines of the Nevada Consolidated Copper Co. 3,609,100 tons of copper ore were treated in 1929, compared with 3,234,600 tons in 1928. Further data for the Ray mines have been blanketed under the main company, the Nevada Consolidated Copper Co., as given under Nevada (p. 565).

Copper produced by the Ray mines of the Nevada Consolidated Copper Co., Arizona, 1920–1929

Year	Ore milled	Copper content	Mill recovery	Refined copper
	Short tons	*Per cent*	*Per cent*	*Pounds*
1920	1,706,928	1.720	81.98	47,062,030
1921	406,172	1.646	77.82	10,110,131
1922	1,178,350	1.587	76.66	27,953,408
1923	2,689,800	1.571	74.87	61,385,205
1924	2,896,700	1.523	78.27	67,017,981
1925	3,037,700	1.500	84.45	74,691,091
1926	2,957,200	(1)	(1)	(1)
1927	2,830,100	(1)	(1)	(1)
1928	3,234,600	(1)	(1)	(1)
1929	3,609,100	(1)	(1)	(1)

[1] Not given separately. In 1926 the copper content of Ray, Nevada, and Chino production was 1.268 per cent, mill recovery 86.26 per cent, and refined copper output 231,119,539 pounds; in 1927 copper content was 1.326 per cent, mill recovery 87.92 per cent, and refined copper output 218,683,930 pounds; in 1928 copper content was 1.363 per cent, mill recovery 86.56 per cent, and refined copper output 268,462,629 pounds; in 1929 copper content was 1.257 per cent, mill recovery 84.74 per cent, and refined copper output 266,274,918 pounds.

Ajo district.—The New Cornelia mines of the Calumet & Arizona Mining Co. produced 5,086,306 wet tons of ore and waste. Of this total 2,460,080 dry tons of ore, containing 1.278 per cent of copper, were sent to the concentrator; 1,122,031 dry tons, containing 1.056 per cent of copper, were sent to the leaching plant; 55 dry tons, containing 33.42 per cent of copper, were sent to the smelter at Douglas; 384,063 dry tons, containing 0.248 per cent of total copper, were sent to the sulphide waste dump; and 1,056,498 dry tons, containing 0.248 per cent of total copper, were sent to the carbonate waste dump. A total of 2,456,304 dry tons of sulphide ore was treated at the concentrating plant, a daily average of 6,880 tons, and 1,122,031 dry tons of carbonate ore were treated at the leaching plant, a daily average of 3,074 tons. The yield of metals is combined with that of the Calumet & Arizona Mining Co. (p. 550). Continued development work, principally drilling, has disclosed further ore.

Copper produced by the New Cornelia Copper Co., 1925–1929, in pounds[1]

	1925	1926	1927	1928
Electrolytic copper	15, 979, 895	17, 405, 991	72, 932, 670	77, 995, 281
Cement copper	1, 305, 265	836, 282		
Copper from concentrates	51, 977, 126	64, 070, 190		
	69, 262, 286	82, 312, 463	72, 932, 670	77, 995, 281

[1] Company consolidated with Calumet & Arizona Mining Co. in 1929 and production in 1929 included with that of latter company (see p. 550).

Pioneer district.—The Magma Copper Co. mined 269,579 tons of ore in 1929, averaging 7.62 per cent of copper, 3.92 ounces of silver, and 0.036 ounce of gold. At the smelter 21,046 tons of concentrates and ore were treated during the year and yielded 38,235,310 pounds of copper, 1,158,735 ounces of silver, and 13,405 ounces of gold. The mill heads averaged 7.05 per cent of copper and the recovery was 98.31 per cent. Development work amounted to 18,785 feet and results were satisfactory.

CALIFORNIA

In California production of blister copper increased from 24,707,992 pounds in 1928 to 33,084,232 pounds in 1929. California remained in eighth place in total production from the beginning of operations, the total output being 1,054,083,426 pounds, or 2.45 per cent of the country's total.

The Engels Copper Mining Co. produced 11,000,162 pounds of copper in 1929, compared with 11,137,234 pounds in 1928. In addition, 114,020 ounces of silver and 1,798 ounces of gold were produced in 1929. The total production of copper since the beginning of operations by the company in 1914 has reached 155,908,040 pounds. The grade of the ore mined in 1929 was 1.524 per cent of copper, compared with 1.710 per cent in 1928. The ore reserves decreased from 556,837 tons, averaging nearly 2 per cent, in 1928 to 327,844 tons, averaging 1.75 per cent, in 1929. The mill treated 395,042 tons of ore, assaying 1.524 per cent of copper; the yield was 39,626,176 pounds of concentrates, which assayed 27.76 per cent of copper.

Cost of producing copper by Engels Copper Mining Co. in 1929

		Total	Per pound of copper
			Cents
Operating cost		$829,367.44	7.5396
Freight and smelting charges	$592,614.69		
Credit value of gold and silver recovered	91,323.37		
		501,291.32	4.5571
Operating and marketing cost		1,330,658.76	12.0967
Depreciation costs		81,293.44	.7390
Development amortization		567,417.71	5.1583
		1,979,369.91	17.9940

Operations at Superior mill in 1929

Ore milled	short tons	395,042
Average heads	per cent	1.524
Average tails	do	.143
Actual extraction	do	91.34
Concentrates produced	pounds	39,626,176
Average content of concentrates	per cent	27.76
Copper produced	pounds	11,000,162
Silver produced	ounces	114,019.83
Gold produced	do	1,797.84

Ore reserves of Engels and Superior mines, December 31, 1929, in short tons[1]

Mine	Blocked ore		Probable ore	Total
	In place	Broken in stopes		
Engels	151,850	105,506	54,493	311,849
Superior	10,598	5,397		15,995
	162,448	110,903	54,493	327,844

[1] This estimate of ore reserves represents ore that assays approximately 1¾ per cent in copper.

Operations by the Walker Mining Co., a subsidiary of Anaconda; were continuous throughout the year; 513,526 tons of ore was broken, and 457,637 tons of ore was treated in the concentrator, yielding 32,375 tons of concentrates. The concentrates averaged 23.56 per cent of copper and the mill heads 1.81 per cent. The company sold to the smelter 32,266 tons of concentrates, which yielded 15,031,978 pounds of fine copper, 294,562 ounces of silver, and 15,400 ounces of gold. The concentrator made an average recovery of 92.1 per cent.

COLORADO

Colorado continued to hold tenth place among the copper-producing States of the country both for 1929 and for total recorded production through 1929. In 1929 the production amounted to 10,519,784 pounds, as compared with 10,262,083 pounds in 1928; practically the entire output was obtained as a by-product from siliceous ores and lead-zinc ores. To date no highly important copper mine has been opened in the State. The total production through 1929 is 339,352,602 pounds, 0.79 per cent of the country's total.

IDAHO

In 1929 the production of blister copper from Idaho amounted to 6,267,487 pounds, compared with 2,336,654 pounds in 1928, and the State ranked twelfth among the copper-producing States. The total output from Idaho through 1929 is 139,498,727 pounds, and the State continues to rank eleventh.

MICHIGAN

Lake Superior district.—In the production of copper from the beginning of operations through 1929 Michigan ranks third among the States, with 8,239,296,838 pounds, or 19.14 per cent of the country's total output of 43,054,487,162 pounds. The 1929 smelter production amounted to 185,300,917 pounds, or 9.25 per cent of the country's total, compared with 179,104,311 pounds in 1928, or 9.81 per cent of the country's total. The Lake Superior district ranks second only to the Butte district in total mine output through 1929, having produced 8,200,774,000 pounds compared with 9,935,112,000 pounds from the Butte district. In 1929 the Lake Superior district ranked fifth in mine output, with 186,402,000 pounds of copper.

Copper ore produced in Lake Superior district, Michigan, 1920–1929

Year	Short tons	Yield of copper (per cent)	Year	Short tons	Yield of copper (per cent)
1920	5,938,967	1.30	1925	7,036,751	1.10
1921	3,610,648	1.20	1926	7,641,682	1.15
1922	4,952,264	1.23	1927	8,046,334	1.10
1923	5,363,160	1.29	1928	7,361,658	1.21
1924	5,372,572	1.26	1929	7,598,180	1.23

As reported by the Calumet & Hecla Consolidated Copper Co. its mines produced 90,319,000 pounds of copper in 1929 at an average cost of 11.43 cents per pound, including cost of selling but no charges for depreciation and depletion, compared with 91,308,000 pounds costing 10.10 cents per pound in 1928. In addition, the reclamation plants at Lake Linden and Hubbell recovered 33,511,000 pounds of copper at an average cost sold of 5.62 cents per pound, compared with 29,896,000 pounds at a cost of 5.95 cents in 1928. The Calumet mill treated 840,960 tons of conglomerate and 249,040 tons of Osceola amygdaloid; the Ahmeek mill treated 1,269,615 tons of Kearsarge and 605,418 tons of Osceola amygdaloid; and the Lake No. 2 mill treated 7,827 tons of Kearsarge and 154,887 tons of Osceola amygdaloid and made a test run of 1,523 tons of conglomerate. The smelter received 101,900 tons of concentrates and mass copper and smelted 97,700 tons, all of which came from the mines and mills of the company; the yield of refined copper was 122,664,000 pounds.

Operations at the Calumet & Hecla reclamation plants at Lake Linden and Hubbell in 1929 and for the entire period of their operation

	1929	Since starting
Quantity treated .... short tons..	2, 444, 000	23, 223, 000
Assay headings .... per cent..	0. 782	0. 681
Assay tailings .... do....	. 100	. 141
Refined copper produced .... pounds..	33, 511, 000	250, 799, 000
Refined copper produced per ton treated .... do....	13. 71	10. 80

The comparative results of operations during the past four years by the Isle Royale Copper Co. are summarized as follows:

Copper produced by the Isle Royale Copper Co., 1926–1929

	1926	1927	1928	1929
Rock hoisted .... short tons..	564, 692	593, 594	560, 598	669, 049
Rock-house discard .... do ...	116, 945	128, 494	119, 867	154, 025
Rock treated .... do....	447, 747	465, 100	440, 731	515, 024
Cost of mining, transportation, stamping, and taxes per ton of rock	$2. 39	$2. 50	$2. 71	$2. 67
Refined copper produced .... pounds..	11, 017, 000	11, 391, 338	10, 520, 771	10, 864, 085
Refined copper per ton of rock treated .... do....	24. 61	24. 49	23. 87	21. 09

The Champion, Baltic, and Trimountain mines produced 24,197,316 pounds of refined copper in 1929, of which 13,866,966 pounds were for the Copper Range Co.; one-half of the output of the Champion belongs to the St. Mary's Mineral Land Co. There was 543,400 tons of rock stamped which yielded an average of 44.53 pounds of copper per ton, compared with 43.39 pounds per ton in 1928.

The Champion Copper Co. stamped 446,804 tons of rock, from which 20,660,701 pounds of copper were obtained, or an average yield of 46.24 pounds per ton. Some 20,408 feet of drifting, raising, etc., was done in the Champion mine in 1929. In addition, considerable drilling was finished during the year. The Baltic mine stamped 53,833 tons of material, from which 2,127,926 pounds of copper were obtained, or a yield of 39.53 pounds per ton. The Trimountain mine stamped 42,763 tons of rock, yielding 1,408,689 pounds of copper, or 32.94 pounds per ton. The reserves at the Champion mine were increased by development work during the year, whereas development work in the Baltic mine disclosed that below the twenty-fifth level the ore body was too short to permit profitable extraction. Further work is planned below the forty-seventh level to determine the character of the lode.

Copper produced by the Champion Copper Co., 1920–1929

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound[1]	Price received	Net profits
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*	
1920	321, 664	13, 610, 324	42. 419	14. 40	17. 17	$399, 772. 65
1921	531, 780	20, 719, 307	39. 018	9. 82	13. 329	719, 955. 51
1922	503, 593	19, 583, 806	38. 964	9. 93	14. 359	890, 515. 16
1923	449, 130	18, 412, 630	41. 03	11. 14	14. 86	738, 871. 98
1924	457, 160	20, 061, 630	43. 88	10. 49	13. 76	709, 276. 53
1925	414, 645	17, 957, 605	43. 308	11. 73	14. 258	497, 764. 43
1926	454, 654	17, 658, 820	38. 84	10. 83	13. 948	597, 042. 27
1927	403, 260	16, 098, 926	39. 92	10. 84	13. 42	455, 791. 07
1928	427, 240	19, 563, 535	45. 79	11. 10	15. 01	829, 357. 45
1929	446, 804	20, 660, 701	46. 24	12. 00	17. 94	1, 267, 685. 97

[1] Excludes depreciation and depletion.

Copper produced by the Baltic mine, 1920–1929

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound[1]	Price received	Net loss
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*	
1920	175, 357	6, 613, 918	37. 71	18. 02	17. 11	$59, 882. 60
1921	195, 816	7, 608, 847	38. 86	14. 15	13. 078	81, 668. 95
1922	165, 804	5, 329, 568	32. 14	16. 76	13. 958	149, 578. 09
1923	137, 801	4, 877, 248	35. 51	18. 42	14. 626	189, 880. 94
1924	150, 101	4, 769, 286	31. 77	15. 95	13. 76	104, 574. 24
1925	140, 958	4, 255, 069	30. 18	17. 74	14. 25	148, 517. 14
1926	126, 157	3, 690, 041	29. 25	18. 28	13. 94	160, 073. 52
1927	121, 504	4, 207, 819	34. 63	13. 50	13. 42	3, 120. 98
1928	92, 742	3, 415, 082	36. 82	14. 54	15. 01	[2] 16, 085. 53
1929	53, 833	2, 127, 926	39. 53	20. 87	17. 94	62, 339. 97

[1] Excludes depreciation and depletion.

[2] Net profit.

Copper produced by the Trimountain mine, 1920–1929

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound[1]	Price received	Net loss
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*	
1920	116, 768	3, 532, 025	30. 24	25. 51	17. 115	$247, 390. 52
1921	143, 172	4, 341, 584	30. 32	18. 27	13. 078	183, 560. 50
1922	130, 913	4, 116, 100	31. 44	16. 47	13. 95	67, 576. 58
1923	6, 273	281, 482	44. 87	([2])	14. 62	140, 563. 74
1924	8, 159	278, 259	34. 10	([2])	13. 76	87, 053. 47
1925	35, 465	1, 065, 044	30. 03	([2])	14. 25	39, 302. 47
1926	63, 837	2, 177, 416	34. 11	13. 43	13. 94	[3] 11, 253. 16
1927	67, 281	2, 354, 808	35. 00	12. 25	13. 42	[3] 27, 476. 86
1928	38, 950	1, 275, 515	32. 74	16. 90	15. 01	24, 100. 34
1929	42, 763	1, 408, 689	32. 94	22. 06	17. 94	57, 968. 20

[1] Excludes depreciation and depletion.

[2] Figures not given.

[3] Net profit.

The Mohawk Mining Co. produced 637,156 tons of rock, of which 619,585 tons were stamped. The rock stamped produced 27,865,390 pounds of mineral from which 20,043,127 pounds of refined copper were produced. The rock treated averaged 32.349 pounds of copper to the ton compared with 32.346 pounds in 1928. The total cost of delivered refined copper during the year was reported by the company as 7.316 cents per pound.

Copper produced by the Mohawk Mining Co. in 1929

Rock hoisted	short tons	637, 156
Rock stamped	do	619, 585
Product of mineral	pounds	27, 865, 390
Refined copper produced	do	20, 043, 127
Yield per ton of rock treated	do	32. 349
Cost per ton of rock hoisted		$1. 808
Cost per ton of rock stamped		$1. 859
Operating cost per pound of refined copper	cents	5. 746
Cost of taxes	do	. 291
Cost of smelting, freight, and marketing product, including eastern offices' expenses	cents	1. 279
		7. 316

The Quincy Mining Co. produced 7,088,500 pounds of mineral, yielding 4,459,426 pounds of refined copper in 1929. The development work consisted of 10,235 feet in No. 2 shaft, 10,570 feet in No. 6 shaft, and 2,921 feet in No. 8 shaft, a total of 23,726 feet. Of the material stamped about 22 per cent came from stopes at No. 8 shaft. New flotation machines and grinding apparatus were added to the stamp mill during the year.

Copper produced by the Quincy Mining Co., 1924–1929

Year	Copper rock and mass	Mineral	Copper	Yield of copper per ton of rock
	Short tons	*Pounds*	*Pounds*	*Pounds*
1924	588, 100	24, 489, 920	14, 838, 633	25. 24
1925	586, 913	22, 721, 380	14, 357, 523	24. 46
1926	517, 900	20, 220, 795	13, 290, 052	25. 66
1927	413, 000	15, 336, 690	9, 718, 662	23. 53
1928	60, 834	1, 891, 200	1, 220, 536	20. 06
1929	207, 833	7, 088, 500	4, 459, 426	21. 46

MISSOURI

During 1929 Missouri produced 1,880 pounds of blister copper, compared with 930 pounds in 1928.

MONTANA

Among the copper-producing States, Montana stands second only to Arizona in total recorded production through 1929, but in output for 1929 Montana ranked third among the copper-producing States. The smelter output of the State was 299,894,853 pounds in 1929, or 14.97 per cent of the Nation's total, and the total output through 1929 is 10,004,438,776 pounds, or 23.24 per cent of the country's total. Montana has only one outstanding copper-producing district—the Butte.

Butte district.—The Butte district continues as the leading district in the United States in total production of copper since the beginning of operations. Through 1929 Butte has produced a total of 9,935,112,000 pounds of copper; it produced 296,316,000 pounds in 1929, compared with 247,067,000 pounds in 1928. The Anaconda Copper Mining Co. is by far the most important producer in the district.

The output of the Butte district for a number of years is given in the following table.

Copper and associated metals produced in Butte district, Montana, 1920–1929

Year	Copper	Gold	Silver	Year	Copper	Gold	Silver
	Pounds		*Ounces*		*Pounds*		*Ounces*
1920	176,399,000	$643,595	10,570,676	1925	266,637,000	$746,422	11,561,659
1921	47,958,000	280,085	4,980,285	1926	252,991,000	678,290	11,058,861
1922	165,374,000	540,936	10,394,811	1927	221,312,000	540,827	9,658,204
1923	223,043,000	624,528	11,835,643	1928	247,067,000	595,495	9,558,587
1924	247,364,000	730,646	11,859,290	1929	296,316,000	538,419	9,918,841

The Anaconda Copper Mining Co. and its subsidiaries produced the following amounts of metals from its copper operations during 1929.

Metals produced by Anaconda Copper Mining Co. and its subsidiaries from copper operations in 1929

	Copper	Silver	Gold
	Pounds	*Ounces*	*Ounces*
Anaconda Copper Mining Co	297,014,107	8,564,609.45	33,077.043
Andes Copper Mining Co	162,663,775	263,268.65	16,536.862
Chile Copper Co	299,575,752		
Greene Cananea Copper Co	58,826,951	402,029.94	12,365.615
International Smelting Co	172,488,878	2,154,868.63	44,441.157
	990,569,463	11,384,776.67	106,420.677

Of the above, 188,050,954 pounds of copper, 3,598,424.07 ounces of silver, and 55,079.558 ounces of gold were produced from custom ores and ores treated on toll.

Total expenditures for construction during 1929 were $9,596,570; they were distributed as follows:

Butte mines	$1,059,487.76
Reduction works, Anaconda	232,851.72
Reduction works, Great Falls	54,408.63
American Brass Co	1,583,072.20
Raritan Copper Works	244,893.29
International Smelting Co	872,446.61
International Lead Refining Co	208,949.04
Andes Copper Mining Co	2,025,793.29
Chile Copper Co	2,346,257.91
Greene Cananea Copper Co	939,195.31
Miscellaneous	29,213.78

During the year the Anaconda Wire & Cable Co. was organized to take over the Great Falls rod and wire mill of the company and the Kenosha wire mill of the American Brass Co.; it subsequently acquired the plants and assets of the following companies: Inland Wire & Cable Co., Sycamore, Ill.; Tubular Woven Fabrics Co., Pawtucket, R. I.; Maring Wire Co., Muskegon, Mich., and Anderson, Ind.; Marion Insulated Wire & Rubber Co., Marion, Ind.; and Hastings Wire & Cable Corporation (subsidiary of the American Brass Co.), Hastings upon Hudson, N. Y.

The American Brass Co. acquired the French Manufacturing Co., of Waterbury, Conn.

Net earnings (including those of subsidiary companies) for the year, after deducting all charges except depletion, amounted to $73,196,596.

Copper, gold, and silver produced by Anaconda Copper Mining Co. from company ores, 1920–1929

Year	Copper ore treated	Copper	Silver	Gold	Dividends
	Short tons	*Pounds*	*Ounces*	*Ounces*	
1920	1,828,380	138,763,065	6,420,026	32,530	$6,993,750
1921	395,239	32,267,345	2,137,062	8,619	------------
1922	1,878,162	141,741,235	6,755,212	25,720	------------
1923	2,735,534	200,779,688	8,568,607	29,726	9,000,000
1924	3,017,417	238,247,038	8,345,841	37,689	2,250,000
1925	2,750,736	266,373,956	9,054,741	38,390	9,000,000
1926	2,570,162	254,302,568	8,226,724	31,764	9,000,000
1927 [1]	2,866,785	221,300,270	6,638,127	32,674	9,000,000
1928 [1]	2,975,206	247,577,554	6,165,123	36,564	14,419,034
1929 [2]	([3])	297,014,107	8,564,609	33,077	53,567,278

[1] Reported in 1927 and 1928 as tonnage treated in plant and production, including purchased and toll material.

[2] Includes metals from custom ores and ores treated on toll.

[3] Not given.

The Butte & Superior Mining Co. in 1929 produced 5,225 dry tons of copper ore, the metal content of which was as follows: Copper, 328,248 pounds (3.14 per cent); gold, 22 ounces; silver, 25,822 ounces; lead, 28,200 pounds; and zinc, 264,985 pounds. The company also produced a total of 225,689 tons of zinc ore which contained 1,994 ounces of gold, 1,434,772 ounces of silver, 937,647 pounds of copper, 5,864,195 pounds of lead, and 59,541,660 pounds of zinc. At the beginning of 1929 reserves amounted to 151,924 tons of zinc ores averaging 15.03 per cent of zinc and 5.28 ounces of silver, compared with 183,048 tons averaging 14.77 per cent of zinc and 5.55 ounces of silver at the beginning of 1930.

The East Butte Mining Co. mined 96,569 dry tons of copper ore, averaging 4.17 per cent of copper and 4.13 ounces of silver, from which were obtained 6,984,238 pounds of copper and 345,831 ounces of silver. In addition, 30 tons of copper precipitates at the Pittsmont mine, assaying 69.09 per cent of copper, yielded 39,888 pounds of copper. Development work amounted to 7,987 feet during 1929.

Copper operations of East Butte Copper Mining Co. in 1929

Ore mined (dry weight), Pittsmont	short tons	96,569
Average assay value, copper	per cent	4.17
Average assay value, silver	ounces	4.13
Copper produced	pounds	6,984,238
Silver produced	ounces	345,831
Copper precipitates produced (dry weight), Pittsmont	short tons	30
Average assay value	per cent	69.09
Copper produced	pounds	39,888
Price per pound copper received	cents	18.1295
Cost per pound copper delivered	do	17.2948
Profit per pound	do	.8347

NEVADA

In 1929 Nevada produced 138,990,247 pounds of copper, 6.94 per cent of the total for the country, and again ranked fifth among the copper-producing States. From the beginning of operations through 1929 Nevada has produced 1,721,485,350 pounds, or 4 per cent of the country's total, and also ranks fifth. Most of the copper produced in Nevada comes from the Ely (Robinson) district.

Ely (Robinson) district.—The mine production in the Ely district in 1929 amounted to 130,755,000 pounds, compared with 141,969,000 pounds in 1928. Through 1929 this district has produced a total of 1,542,289,000 pounds, or 3.58 per cent of the country's total, and ranks eighth among the districts. The Nevada Consolidated Copper Co. produces most of the output of the district and the State.

Production of metals in Ely (Robinson) district, Nevada, 1920–1929

[Mine figures]

Year	Ore	Copper produced	Average yield in copper	Gold and silver per ton of ore
	Short tons	*Pounds*	*Per cent*	*Cents*
1920	2,589,546	48,347,828	0.93	21
1921	400,810	10,282,527	1.28	25
1922	630,871	22,614,736	1.79	19
1923	2,833,674	65,928,279	1.16	24
1924	3,505,362	73,279,064	1.05	21
1925	3,922,770	78,627,308	1.00	21
1926	4,672,240	95,009,115	1.02	18
1927	4,488,009	107,441,000	1.20	24
1928	5,730,471	141,969,000	1.24	28
1929	6,378,138	130,755,000	1.03	22

At the Nevada mines of the Nevada Consolidated Copper Co. 5,220,987 dry tons of ore was taken from the shovel pits and underground workings and delivered to the mill. This, with 1,033,042 dry tons of custom ore, brought the total ore concentrated up to 6,254,029 dry tons, an average of 17,134 tons daily; the cost of milling, exclusive of depreciation and taxes but including all other expenses, was 42.10 cents per ton. At the company's Ray mines, in Arizona, 3,609,100 dry tons of ore, or an average of 9,888 tons per day, was handled in the Hayden concentrator at a cost of 39.45 cents per ton. At the company's Chino mines, in New Mexico, a total of 3,973,300 dry tons, or an average of 10,886 tons per day, was handled, all of which went through the Hurley concentrator; the milling cost, exclusive of depreciation and taxes, was 59 cents per ton. The total ore milled at the three properties was 13,836,429 tons, an average of 37,908 tons per day. The average grade of all ore handled by the company was 1.257 per cent of copper and the average recovery in the form of concentrates was 84.74 per cent of the total copper content. This amounted to 21.30 pounds of copper per ton of ore treated. The total ore produced from the company's mines and treated during the year amounted to 12,888,289 tons, of which 12,803,387 tons, an average of 35,078 tons per day, was concentrated. A total of 84,902 tons of company crude ore was shipped to the smelters and 1,033,042 tons of contract and other custom ore was milled. The total yield of company copper was 266,274,918 pounds. The company reports an approximate ore reserve of 273,500,000 tons for the three mines.

Metals produced by the Nevada mines of the Nevada Consolidated Copper Co., 1920–1929

Year	Ore treated	Average assay of copper	Average extraction of copper	Refined copper produced
	Short tons	*Per cent*	*Per cent*	*Pounds*
1920	2,568,588	1.449	70.20	48,311,985
1921	392,645	1.49	75.23	9,362,325
1922	518,523	1.60	75.19	23,762,675
1923	2,576,388	1.31	82.90	61,573,246
1924	3,418,900	1.198	87.09	70,237,050
1925	[1] 3,234,390	[1] 1.21	92.24	73,653,886
1926	[2] 4,568,272	(3)	(3)	(3)
1927	[4] 4,376,295	(3)	(3)	(3)
1928	[5] 5,605,960	(3)	(3)	(3)
1929	[6] 6,254,029	(3)	(3)	(3)

[1] In addition, 598,114 dry tons of porphyry sulphide material, averaging 0.684 per cent copper, was concentrated, giving a recovery in electrolytic copper of 9.63 pounds to a ton milled.

[2] Includes 208,143 tons of custom ore.

[3] Not given separately. In 1926 the copper content of Ray, Nevada, and Chino production was 1.268 per cent, mill recovery 86.26 per cent, and refined copper output 231,119,539 pounds; in 1927 copper content was 1.326 per cent, mill recovery 87.92 per cent, and refined copper output 218,683,930 pounds; in 1928 copper content was 1.363 per cent, mill recovery 86.56 per cent, and refined copper output 268,462,629 pounds; in 1929 copper content was 1.257 per cent, mill recovery 84.74 per cent, and refined copper output 266,274,918 pounds.

[4] Includes 600,502 tons of custom ore.

[5] Includes 941,942 tons of custom ore.

[6] Includes 1,033,042 tons of custom ore.

The Consolidated Coppermines Corporation in 1929 produced 22,731,703 pounds of copper, 11,950 ounces of gold, 30,159 ounces of silver, and 34,315 pounds of lead from 1,071,196 tons of ore averaging 1.26 per cent of copper. A total of 27,733 feet of development work was done in 1929. Most of the tonnage mined came from the Morris-Brooks and Emma mines. Primary commercial ores were encountered between the Emma Nevada and Morris-Brooks mines, opening up a large area for prospecting. Previously it was believed that the commercial ores were formed almost entirely through secondary enrichment processes.

Yerington district.—Operations ceased at the Mason Valley Mines Co.'s plant on March 31, 1929. The Eastern Iron & Metal Co. purchased the property and dismantled the smelter. The Mason Valley Mines Co. is distributing assets as a result of proposed liquidations. Shipments are being made by lessees.

NEW MEXICO

From the beginning of operations to the end of 1929 New Mexico has produced 1,313,016,526 pounds of copper, or 3.05 per cent of the country's total output of 43,054,487,162 pounds, and ranks sixth among the producing States. New Mexico ranked sixth also in production in 1929, with an output of 100,165,206 pounds, or 5 per cent of the country's total. The Santa Rita district produces most of the copper from New Mexico, and the Chino mines of the Nevada Consolidated Copper Co. furnish most of the district production.

Central (*including Santa Rita*) *district.*—The Central district, with a production of 1,155,077,000 pounds from the beginning of operations through 1929, ranks ninth among the copper-producing districts. The production for several years is shown in the following table.

Copper produced in Central (including Santa Rita) district, New Mexico, 1920–1929, in pounds

[Mine figures]

1920	44, 400, 000	1925	68, 812, 000
1921	9, 138, 000	1926	75, 219, 000
1922	28, 408, 000	1927	66, 971, 000
1923	54, 375, 000	1928	80, 239, 000
1924	66, 824, 000	1929	87, 446, 000

The Chino branch of the Nevada Consolidated Copper Co. concentrated 3,973,300 dry tons of ore in 1929, a daily average of 10,886 tons. The cost of milling, exclusive of taxes and depreciation, was 59 cents per ton. The haulage shaft for the anticipated underground mining operations was concreted to the full depth of 661 feet to the main haulage level. A total of 7,442 feet of development work was completed in the underground section. No underground production is anticipated for the present as the pit operation is in good condition to continue. The findings of previous churn drilling as to tonnage, value of ore, and character of ground have been verified by further work to date. It has been found that mining by caving methods similar to those now used at Ray (Arizona) can be applied at Chino. The cost of open-pit mining was 31.38 cents per ton and stripping operations cost 49.61 cents per cubic yard. The improvements at the Hurley concentrator, begun in 1928, were practically completed at the end of 1929.

Metals produced by the Chino mines of the Nevada Consolidated Copper Co., New Mexico, 1920-1929

Year	Ore milled	Copper content	Mill recovery	Refined copper produced
	Short tons	*Per cent*	*Per cent*	*Pounds*
1920	1, 838, 140	1. 76	70. 67	44, 051, 849
1921	361, 660	1. 70	77. 36	9, 137, 282
1922	1, 416, 869	1. 55	66. 99	28, 406, 314
1923	2, 785, 564	1. 50	66. 34	54, 261, 228
1924	2, 706, 200	1. 59	77. 83	66, 574, 486
1925	3, 002, 700	1. 42	80. 54	67, 385, 620
1926	3, 523, 319	(1)	(1)	(1)
1927	2, 982, 137	(1)	(1)	(1)
1928	3, 596, 144	(1)	(1)	(1)
1929	3, 973, 300	(1)	(1)	(1)

[1] Not given separately. In 1926 the copper content of Ray, Nevada, and Chino production was 1.268 per cent, mill recovery 86.26 per cent, and refined copper output 231,119,539 pounds; in 1927 copper content was 1.326 per cent, mill recovery 87.92 per cent, and refined copper output 218,683,930 pounds; in 1928 copper content was 1.363 per cent, mill recovery 86.56 per cent, and refined copper output 268,462,629 pounds; in 1929 copper content was 1.257 per cent, mill recovery 84.74 per cent, and refined copper output 266,274,918 pounds.

Lordsburg district.—The Eighty-Five mines of the Calumet & Arizona Mining Co. produced 58,722 wet tons of ore in 1929 averaging 2.87 per cent of copper. A total of 5,909 feet of development work was completed, compared with 9,356 feet completed in 1928. Little new ore was encountered during the year. The Jim Crow mine was sunk 853 feet to a depth of 1,118 feet. The production of the Lordsburg district during several years has been as follows:

Copper produced in Lordsburg district, New Mexico, 1920–1929, in pounds

[Mine figures]

1920	2,696,000	1925	5,064,000
1921	579,000	1926	4,763,000
1922	3,217,000	1927	3,933,000
1923	4,314,000	1928	4,625,000
1924	4,928,000	1929	4,248,000

TENNESSEE

For 1929 the Bureau of Mines is not at liberty to publish the production of Tennessee because of objections by the companies concerned; in 1928 Tennessee produced 16,374,261 pounds of blister copper, 0.9 per cent of the country's total, and ranked ninth among the copper-producing States. From the beginning of operations through 1928 Tennessee also ranked ninth, having produced approximately 519,017,000 pounds of copper, or 1.26 per cent of the total output of the country. The entire output comes from the Ducktown district, in Polk County, in the extreme southeastern part of the State.

Copper produced in Ducktown district, Tennessee, 1920–1929

Year	Copper ore treated	Copper produced (smelter)	Average yield of copper	Gold and silver per ton of ore
	Short tons	*Pounds*	*Per cent*	*Cents*
1920	589,853	16,727,803	1.42	21
1921	564,457	15,084,294	1.34	18
1922	557,750	14,226,232	1.28	15
1923	776,477	18,721,932	1.21	12
1924	714,975	18,251,996	1.28	10
1925	794,930	19,789,234	1.24	10
1926	608,040	18,601,586	1.53	12
1927	630,955	14,498,951	1.18	9
1928	759,995	16,374,261	1.08	7
1929	(1)	(1)	(1)	(1)

[1] Bureau of Mines not at liberty to publish figures.

In 1929 the Tennessee Copper & Chemical Corporation and its subsidiaries produced more copper, sulphuric acid, iron sinter, and fertilizer than in any previous year. The combined operating profit reported by these companies was $2,699,195 and the net profit, after deducting depreciation, bond interest, and reserves, was $1,877,432, exceeding the profit in any previous year. The company operated the Burra-Burra and Eureka mines throughout 1929. The Polk County mine was unwatered, and the development work started is giving encouraging results. Ore reserves on January 1, 1930, were estimated at 5,779,559 tons.

Copper and sulphuric acid produced by Tennessee Copper Co., 1920–1929

Year	Ore treated	Copper	Sulphuric acid, 60° Baumé	Year	Ore treated	Copper	Sulphuric acid, 60° Baumé
	Short tons	*Pounds*	*Short tons*		*Short tons*	*Pounds*	*Short tons*
1920	404,060	10,474,881	333,629	1925	516,964	13,625,707	329,395
1921	302,584	8,081,322	242,743	1926	506,527	12,566,665	354,722
1922	287,499	7,553,281	218,676	1927	420,255	11,063,234	291,393
1923	484,324	12,013,988	299,231	1928	(1)	13,585,853	(1)
1924	451,777	12,726,635	247,477	1929	(1)	(1)	(1)

[1] Not given. The production of copper and sulphuric acid in 1929 was reported by the company to be the largest in its history.

UTAH

The smelter production of copper in Utah increased from 298,375,465 pounds in 1928 to 325,965,289 pounds in 1929. The 1929 production represented 16.27 per cent of the total United States output, and Utah again ranked second among the copper-producing States. From the beginning of operations through 1929 Utah has produced a total of 4,349,304,659 pounds of copper, 10.10 per cent of the total for the country, and ranks fourth among the copper-producing States. Utah, like most of the other copper-producing States, has one outstanding district—the Bingham.

Bingham district.—The Bingham district continued as the largest copper-producing district in the country in 1929. In total production from the beginning of operations through 1929 this district ranks fourth, with an output of 3,935,154,000 pounds. The main producer of the district is the Utah Copper Co.

Copper produced in Bingham district, Utah, 1920–1929, in pounds

[Mine figures]

1920	110, 670, 000	1925	227, 612, 000
1921	28, 011, 000	1926	248, 975, 000
1922	91, 762, 000	1927	249, 919, 000
1923	216, 037, 000	1928	287, 685, 000
1924	236, 181, 000	1929	311, 892, 000

The Utah Copper Co. in 1929 produced and shipped to the mills 17,724,100 dry tons of ore, a daily average of 50,210 tons, all of which the company milled. The ore averaged 0.994 per cent of copper, or 19.89 pounds per ton. The average recovery in the form of concentrates was 85.67 per cent, or 17.04 pounds per ton, compared with 85.56 per cent, or 16.97 pounds per ton, in 1928. The mills operated 353 days at an average daily rate of 50,210 tons. The average milling cost was 36.58 cents per ton, compared with 36.9 cents in 1928, a saving of 0.32 cent per ton. The concentrates shipped to the smelter averaged 32.06 per cent and contained 302,013,015 gross pounds of copper, compared with concentrates averaging 31.53 per cent of copper and containing 281,077,725 pounds in 1928. Precipitates derived from mine waters and waste dump waters contained 4,514,498 pounds of copper and brought the production from all sources to 306,527,513 pounds, compared with 283,054,576 pounds in 1928. The net production of refined copper in 1929 was 296,625,554 pounds. The cost of all operations, as usually figured, was 6.65 cents per pound, compared with 6.38 cents per pound in 1928. A total of 193,868,751 tons has been mined to date, and the total ore reserves on December 31, 1929, amounted to 640,000,000 tons averaging 1.07 per cent of copper. This indicates that there will have been mined in all, not allowing for new developments, more than 830,000,000 tons when the present reserves are exhausted.

Metals produced by Utah Copper Co. from ore milled, 1920–1929

Year	Ore milled	Copper content	Mill recovery	Copper[1]	Gold, silver, and miscellaneous income per pound of copper	Dividends (includes capital distribution)
	Short tons	*Per cent*	*Per cent*	*Pounds*	*Cents*	
1920	5,556,800	1.16	81.38	101,897,758	2.09	$9,746,940
1921	1,220,700	1.16	83.87	24,511,593	1.15	4,061,225
1922	4,364,251	1.26	80.00	84,777,712	1.45	3,248,980
1923	11,167,800	1.12	80.96	195,142,919	1.313	6,497,960
1924	12,126,600	1.07	85.94	214,592,733	1.206	6,497,960
1925	12,538,300	1.02	86.96	214,162,139	1.36	6,904,083
1926	13,880,100	1.01	87.01	234,173,625	1.36	8,528,572
1927	13,811,500	.979	89.12	233,002,661	1.16	9,746,940
1928	16,558,500	.992	85.56	273,823,351	1.22	12,995,920
1929	17,724,100	.994	85.67	296,625,554	1.45	32,489,800

[1] Net production of refined copper, not copper content of concentrates.

Cost of mining, milling, and concentrating copper ore by Utah Copper Co., 1920–1929

Year	Ore (short tons)	Cost per ton			
		Mining	Transportation	Milling	Total
1920	5,556,800	$0.4823	$0.2591	$1.2472	$1.9886
1921	1,220,700	.4998	.1921	1.1679	1.8598
1922	4,364,251	.3833	.1612	.8417	1.3862
1923	11,167,800	.3488	.1088	.6116	1.0692
1924	12,126,600	.3605	.1308	.5990	1.0903
1925	12,538,300	.3373	.1151	.5382	.9906
1926	13,880,100	.3139	.1019	.4843	.9001
1927	13,811,500	.3734	.0926	.4523	.9183
1928	16,558,500	.3178	.0874	.3690	.7742
1929	17,724,100	.4121	.0896	.3658	.8675

The Ohio Copper Co. produced 2,215,178 pounds of copper in 1929, compared with 3,973,282 pounds in 1928. The cost per pound of refined copper was 14.0613 cents, compared to 11.4275 cents in 1928. A survey was made during 1928 of the tailings dump; its estimated contents were calculated as 4,995,459 tons containing 0.475 per cent of copper, or 47,405,671 pounds. Preliminary experimental work indicated that this ore can be treated profitably, and further work is being done toward the working out of the best method of handling this material. During the year 7,138 feet of development work was completed. Satisfactory mineralization was disclosed in several places. A 3-compartment shaft was sunk to the 700-foot level and crosscuts were run to the north; some good ore was encountered.

Copper production of the Ohio Copper Co., of Utah, in 1929

	Copper produced	Cost per pound	Price per pound	Profit per pound	Operating profits
	Pounds	*Cents*	*Cents*	*Cents*	
First quarter	568,536	14.1705	18.5373	4.3668	$24,826.76
Second quarter	535,622	14.1071	18.1819	4.0820	21,864.43
Third quarter	552,984	13.7374	17.7125	3.9851	22,037.23
Fourth quarter	558,036	14.2412	17.7125	3.4713	19,371.00
	2,215,178	14.0613	18.0385	3.9772	[1]88,099.42

[1] After adding miscellaneous income and deducting interest on bonds, taxes, insurance, and other miscellaneous charges net profits were $26,828.51. After allowances for depreciation and depletion, a loss of $41,029.69 was deducted from surplus.

Tintic district.—The Tintic district produced 3,166,000 pounds of copper in 1929, compared with 2,457,000 pounds in 1928. From the beginning of operations through 1929 the district has yielded 182,012,000 pounds of copper. The production for several years is shown, as follows:

Copper produced in Tintic district, Utah, 1920–1929, in pounds

[Mine figures]

1920	3, 003, 000	1925	4, 627, 000
1921	1, 570, 000	1926	5, 226, 000
1922	2, 295, 000	1927	3, 783, 000
1923	3, 033, 000	1928	2, 457, 000
1924	3, 076, 000	1929	3, 166, 000

REFINERY PRODUCTION

The refinery output of copper in the United States in 1929 was made by 11 plants—7 of these employed the electrolytic method, 3 employed the furnace process on Lake Superior copper, and 1 the furnace process on Arizona ore.

Five of the large electrolytic refineries are on the Atlantic seaboard, and the three Lake refineries are on the Great Lakes; only three plants are west of the Great Lakes—one at Great Falls, Mont., one at Tacoma, Wash., and one at Clifton, Ariz. In addition to these refineries are the electrolytic plants at Ajo and Inspiration, Ariz., which make electrolytically refined copper directly from the liquors obtained from leaching operations; this copper is shipped as cathodes to eastern refineries, where it is melted and cast into merchant shapes, and is accounted for in the production reported from these eastern refineries. There are also numerous plants in different parts of the country that make a considerable output from old copper and from brass and other alloys of copper. The output of the regular refining plants is in the form of casting, Lake, and electrolytic copper.

Refinery production from ores of domestic and foreign origin is shown in the table on page 573. The domestic figure is the one that is to be compared with smelter production from domestic sources, the main difference being the time factor explained in the introduction to this report; the figures for refinery production include copper that was mined some three months earlier than the beginning of the calendar year and smelted probably one or two months earlier.

CASTING AND PIG COPPER

Blister copper that is low in precious metals and free enough from impurities for certain uses is refined by the furnace process and ordinarily cast into ingots. This copper is usually unfit for uses requiring a high-grade copper, such as electric transmission, brass manufacture, and rolling, but is suitable for copper castings, and a large part of it is put to that use. Lake copper excepted, a comparatively small percentage of the copper output carries so small a content of precious metals that, together with the added value of electrolytic copper, it will not more than pay for the electrolytic refining of the copper; consequently the output of casting copper is small. Some blister or pig copper low in precious metals has been exported without further treatment and is probably consumed without electrolytic refining. Some of the districts produced a rather high grade of blister copper carrying a small amount of precious metals, and it is found profitable to market some of this copper without electrolytic refining. During 1929 the production of furnace-refined new casting copper from domestic and foreign sources amounted to 12,501,718 pounds. No unrefined pig and best select copper was reported as produced in 1929.

LAKE COPPER

Lake copper, as the term is used in this report, means the output of the Lake smelters. Formerly a considerable proportion of this output was refined electrolytically. Most of the electrolytically refined Lake copper is mixed with furnace-refined copper or is sold as some brand of Lake copper. Since December, 1922, the electrolytic plant of the Calumet & Hecla Consolidated Copper Co. has not been in commission because the silver content of the copper was not sufficient to pay for its recovery. The production of Lake copper in 1929 amounted to 185,300,917 pounds.

ELECTROLYTIC COPPER

In 1929 the approximate production of electrolytic copper from primary materials of domestic origin amounted to 1,785,754,654 pounds and from materials of foreign origin to 756,555,087 pounds, and, in addition, production from secondary sources amounted to 331,858,103 pounds—a total electrolytic production of 2,874,167,844 pounds for 1929, compared with 2,492,230,091 pounds for 1928.

REFINED COPPER

The total output of new refined copper in 1929 was 2,740,112,376 pounds, an increase of 252,504,597 pounds over that in 1928. Adding to the new refined copper produced from domestic and foreign sources the imports of refined copper gives the new copper made available for consumption during the year. In the following table is shown also the production of secondary copper by the regular refineries, but not the output of plants that treat only secondary material; the latter is shown in the second table on page 573.

Primary and secondary copper produced by regular refining plants in the United States and imported, 1924–1929, in pounds

	1924	1925	1926	1927	1928	1929
Primary:						
Domestic[1]—						
Electrolytic	1, 499, 223, 447	1, 533, 995, 439	1, 553, 041, 424	1, 520, 076, 181	1, 607, 120, 026	1, 785, 754, 654
Lake	145, 333, 227	138, 029, 764	172, 372, 304	195, 135, 199	179, 104, 311	185, 300, 917
Casting	29, 657, 925	10, 870, 144	5, 883, 433	3, 740, 819	5, 573, 050	11, 676, 718
	1, 674, 214, 599	1, 682, 895, 347	1, 731, 297, 161	1, 718, 952, 199	1, 791, 797, 387	1, 982, 732, 289
Foreign[1]—						
Electrolytic	577, 100, 034	516, 632, 530	588. 932, 788	605, 748, 329	693, 787, 036	756, 555, 087
Casting and best select	8, 761, 377	5, 045, 947	2, 255, 427	1, 063, 181	2, 023, 356	825, 000
Refinery production, new copper	2, 260, 076, 010	2, 204, 573, 824	2, 322, 485, 376	2, 325, 763, 709	2, 487, 607, 779	2, 740, 112, 376
Imports refined copper	145, 909, 968	99, 773, 546	170, 565, 766	103, 279, 082	84, 730, 630	134, 014, 792
Total new refined copper made available	2, 405, 985, 978	2, 304, 347, 370	2, 493, 051, 142	2, 429, 042, 791	2, 572, 338, 409	2, 874, 127, 168
Secondary:						
Electrolytic	104, 281, 430	140, 349, 541	163, 061, 465	168, 766, 566	191, 323, 029	331, 858, 103
Casting	50, 536, 678	58, 010, 653	62, 056, 941	41, 102, 000	41, 322, 776	2, 300, 000
	154, 818, 108	198, 360, 194	225, 118, 406	209, 868, 566	232, 645, 805	334, 158, 103
Grand total	2, 560, 804, 086	2, 502, 707, 564	2, 718, 169, 548	2, 638, 911, 357	2, 804, 984, 214	3, 208, 285, 271

[1] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation at this stage of manufacture is not possible.

If the output of plants treating only secondary material is added to the production of the regular refining companies, the contribution from plants in the United States to the world's supply of copper for 1929 is found to be 3,993,200,000 pounds.

SECONDARY COPPER

Under secondary copper is considered material recovered from remelting old copper, copper scraps, and copper recovered from the treatment of copper alloys or alloys that are treated without the separation of the copper. A canvass of plants producing secondary copper has been made by J. P. Dunlop, of the Bureau of Mines, and the following figures are taken from his report on secondary metals in Mineral Resources.

Secondary copper recovered in the United States in 1929 and imports and exports of scrap brass and copper, in short tons

Copper as metal	297, 600
Copper in alloys other than brass	120, 000
	417, 600
Copper from new scrap (not including brass)	113, 000
Copper from old scrap (not including brass)	304, 600
	417, 600
Brass scrap remelted:	
New clean scrap	156, 000
Old scrap	142, 500
	298, 500

Copper content of brass scrap (averaging about 70 per cent copper).	
New clean scrap	109, 200
Old scrap	99, 750
	208, 950
Total copper produced from secondary sources (including copper content of brass scrap):	
From new scrap	222, 200
From old scrap	404, 350
	626, 550
Imports of scrap brass	7, 031
Imports of scrap copper	6, 797
Exports of scrap brass	26, 867
Exports of scrap copper	18, 818

Refined copper from secondary sources produced in the United States, 1920–1929, in pounds

1920	624, 920, 000	1925	840, 420, 000
1921	434, 600, 000	1926	959, 600, 000
1922	671, 800, 000	1927	980, 400, 000
1923	821, 800, 000	1928	1, 072, 800, 000
1924	776, 600, 000	1929	1, 253, 100, 000

COPPER SULPHATE

The production of hydrous copper sulphate or bluestone by the copper refineries of the United States in 1929 was 40,258,860 pounds, having a copper content of 10,255,000 pounds, compared with 44,463,270 pounds, having a copper content of 11,326,000 pounds, in 1928.

STOCKS

Stocks of copper in the United States, January 1, 1921–1930, in pounds

Year	Refined copper	Blister and materials in process of refining	Year	Refined copper	Blister and materials in process of refining
1921	659, 000, 000	465, 000, 000	1926	124, 000, 000	432, 000, 000
1922	459, 000, 000	283, 000, 000	1927	146, 000, 000	455, 000, 000
1923	216, 000, 000	361, 000, 000	1928	171, 000, 000	401, 000, 000
1924	264, 000, 000	432, 000, 000	1929	114, 000, 000	423, 000, 000
1925	243, 000, 000	393, 000, 000	1930	306, 000, 000	500, 000, 000

IMPORTS AND EXPORTS

The imports of unmanufactured copper in 1929 amounted to 974,312,201 pounds. This exceeds by 187,238,561 pounds the previous record imports of unmanufactured copper, in 1928. Large quantities of unrefined copper were imported from the Belgian Congo, as well as from Canada, Chile, Mexico, and Peru, for refining in the United States, and large quantities of ore and concentrates were received from Canada, Chile, Cuba, Mexico, and Spain. The only important quantity of refined copper imported was from Chile. Virtually all of the ore and blister produced in Chile but not refined there is sent to the United States for treatment.

Copper (unmanufactured) imported into the United States, 1927–1929, in pounds

[General imports]

Country	Ore (copper content)	Concentrates (copper content)	Matte and regulus (copper content)	Unrefined black blister and converter copper in pigs or converter bars	Refined in ingots, plates, or bars	Old and scrap fit only for remanufacture	Composition metal, copper chief value
1927							
Africa:							
Belgian Congo	1,010	-----	-----	114,482,007	-----	-----	-----
Union of South	-----	-----	-----	2,697,436	165	-----	-----
Australia	307,397	-----	-----	-----	-----	-----	-----
Canada	40,496,764	10,537,756	-----	51,480,389	825,843	5,639,111	-----
Chile	35,247,293	5,548,687	14,970	63,697,974	100,839,354	272,738	-----
Cuba	4,263,985	25,108,017	-----	241,920	35,496	628,987	-----
France	123,081	89,808	-----	123,309	-----	-----	300
Germany	342,342	115,785	68,896	-----	557,701	165,932	57,342
Mexico	6,650,973	25,286,667	1,210,431	82,984,970	-----	132,337	-----
Peru	1,989,847	19,112	84,896	101,870,992	-----	73,744	-----
Spain	8,463,703	-----	-----	-----	-----	-----	-----
United Kingdom	78,848	121,692	14,275	19,509,068	1,009,323	72,853	-----
Venezuela	136,572	1,364,366	-----	-----	-----	37,380	-----
Other	1,226,558	910	-----	1,505,948	11,200	454,530	-----
	99,328,373	68,192,800	1,393,468	438,594,013	103,279,082	7,477,612	57,642
Total value	$10,757,297	$8,106,626	$131,092	$51,954,453	$13,105,086	$698,494	$14,573
1928							
Africa:							
Belgian Congo	-----	-----	-----	113,999,871	-----	-----	-----
British—							
East	-----	-----	-----	4,701,706	-----	-----	-----
Union of South	721,110	54,160	-----	2,868,195	-----	31,200	-----
Mozambique	-----	-----	-----	13,906,012	-----	-----	-----
Australia	315,987	-----	-----	54,000	-----	-----	-----
Canada	48,084,775	1,040,490	-----	95,681,502	150,124	7,883,497	17,713
Chile	34,275,132	328,328	12,437	95,767,272	83,733,020	15,230	-----
Cuba	2,740,181	11,438,200	-----	-----	-----	550,618	-----
France	275,790	128,269	40,842	52,120	33,506	27,537	-----
Germany	300,986	78,833	-----	170,441	769,180	92,179	164,563
Mexico	7,756,953	26,296,272	2,536,922	95,691,530	-----	87,887	-----
Peru	927,218	-----	50,283	115,595,856	-----	-----	-----
Spain	9,054,542	59,387	-----	279,639	-----	-----	-----
United Kingdom	202,217	-----	-----	3,668,875	-----	1,383,251	-----
Venezuela	-----	-----	-----	-----	-----	41,978	-----
Other	1,536,831	48,610	-----	753,121	44,800	519,130	33,332
	106,191,722	39,472,549	2,640,484	543,190,140	84,730,630	10,632,507	215,608
Total value	$11,589,484	$4,860,595	$284,656	$67,595,061	$12,634,463	$969,382	$31,718
1929							
Africa:							
Belgian Congo	263,720	-----	-----	55,091,068	-----	-----	-----
British—Union of South	30,805	179,999	-----	-----	-----	-----	-----
Mozambique	931	2,900	52,924	7,803,865	-----	-----	-----
Australia	186,762	-----	-----	-----	-----	-----	-----
Canada	54,844,182	5,833,620	217,780	132,519,194	679,315	11,394,168	5,002
Chile	40,534,646	1,071,394	-----	164,265,111	133,082,539	14,812	-----
Cuba	339,713	9,810,270	-----	-----	-----	1,091,152	-----
France	1,185,755	1,111,870	-----	3,717,719	20,616	49,625	-----
Germany	1,653,882	1,418,540	105,665	7,114,367	232,322	151,644	74,214
Mexico	1,447,954	29,909,338	890,490	138,174,222	-----	148,426	-----
Peru	7,005,284	50,594	74,096	117,772,651	-----	27,509	-----
Spain	14,633,315	-----	-----	2,246,767	-----	-----	-----
United Kingdom	1,019,777	9,903	-----	14,435,473	-----	10,280	560
Venezuela	-----	-----	-----	-----	-----	91,696	-----
Other	1,472,286	4,330,397	763,500	3,026,618	-----	618,854	120
	124,619,012	53,728,825	2,104,455	646,167,055	134,014,792	13,598,166	79,896
Total value	$15,358,271	$7,907,180	$292,316	$104,306,141	$23,757,421	$1,823,464	$12,064

Copper (unmanufactured) imported into the United States, 1920–1929, in pounds

[General imports]

1920	485, 670, 691	1925	652, 971, 407
1921	350, 472, 611	1926	779, 441, 803
1922	541, 013, 220	1927	718, 322, 990
1923	676, 473, 338	1928	787, 073, 640
1924	768, 813, 731	1929	974, 312, 201

According to the Bureau of Foreign and Domestic Commerce, as shown in the following table, 5,579,430 pounds of copper in "ore, concentrates, composition metal, and unrefined copper" was exported in 1929. The chief item in this figure is blister copper. In 1929, as in 1928, the copper producers reported that much more than this amount of blister was exported. It develops that considerably more than twice the quantity of blister copper recorded as exported in 1929 and nearly ten times that recorded for 1928 was exported but was incorrectly classified as "refined copper" in the compilation of customs statistics.

In 1929 the United States exported more copper to the United Kingdom than to any other country; Germany stood second in order of importance and France third. In 1928 and 1927 Germany was first, with the United Kingdom second and France third. The exports (in millions of pounds) from the United States to the six leading importers of United States copper in 1929 were as follows: United Kingdom 217, Germany 200, France 181, Italy 88, Canada 76, and Belgium 49, compared with exports to the six leading importers in 1928 as follows: Germany 235, United Kingdom 217, France 177, Italy 120, Belgium 80, and Netherlands 76.

Copper exported from the United States, 1928 and 1929, in pounds

Country	Ore, concentrates, composition metal, and unrefined copper (copper content) [1]	Refined [1]		Old and scrap	Pipes and tubes	Plates and sheets	Wire (except insulated)	Insulated wire and cable	Other manufactures of copper
		Bars, ingots, or other forms	Rods						
1928									
Belgium		77,431,816	2,678,650	333,078	249	420	4,438	39,410	(2)
Canada	154,093	21,161,866	25,033,498	5,015,354	2,369,599	2,420,475	1,743,056	2,664,428	
China		5,892,175		40,964		33,439	259,513	211,136	
Denmark		1,998,350	1,457,494		3,450	644	224,789	52,734	
France	22,415	171,440,871	1,166,340	3,715,460	221	112,366	120,287	114,233	
Germany	2,041,492	206,549,919	33,584	23,581,476	229	504,061	2,552,020	43,840	
India (British)		2,449,157	324,209	449,130	10,267	279,695	525,157	293,034	
Italy	1,345,580	116,547,931	224,397	262,123	440	279,181	533,684	447,423	
Japan		32,395,333	47,572	10,421,220		19,031	237,401	102,699	
Netherlands	154,116	64,526,417	2,525,531	7,972,816	5,762	404,036	508,628	196,355	
Norway	72,527	2,405,799	2,602,047	41,219		1,959	284	20,730	
Spain		3,321,076	2,701	1,312,277	1,260	650	141,070	122,305	
Sweden		28,704,670	226,367				1,956	13,693	
Switzerland		705,289					1,438	4,988	
United Kingdom	41,754	185,816,840	26,954,825	2,082,591	25,448	724,996	193,159	1,015,801	
Other	800	28,126,947	8,047,860	238,847	1,137,316	1,258,504	8,628,871	14,308,296	
Total value	3,832,777 $508,112	949,474,456 $140,339,589	71,325,075 $11,066,251	55,466,555 $6,994,196	3,554,241 $901,336	6,039,457 $1,275,305	15,675,751 $2,623,986	19,651,105 $4,816,608	(2) $1,296,996
1929									
Belgium		45,749,962	2,533,960	614,347			1,360	35,455	(2)
Canada	597,049	38,691,880	22,171,079	4,462,840	2,569,479	3,107,052	1,739,064	3,042,952	
China		5,604,022		54,480	5,613	18,006	596,815	384,296	
Denmark		1,776,102	336,208			3,528	18,543	33,839	
France		175,264,821	2,500,331	2,654,547	617		48,686	132,179	
Germany	375,550	178,879,194	72,372	19,189,236	243	672,451	609,875	12,338	
India (British)		4,043,059	90,513	157,290	31,569	14,281	353,961	450,979	
Italy		84,491,310	313,944	279,512		651,664	681,485	1,231,826	
Japan		7,953,500	46,601	4,128,957	3,032	3,475	186,561	178,484	
Netherlands	33,997	32,534,775	5,436,278	2,960,086	6,881	112,497	60,901	103,191	
Norway		1,366,156	2,573,618	26,400	5,351		16,038	21,846	
Spain		2,252,963		1,073,444	5,731		60,029	53,148	
Sweden		32,495,033	504,674	12,503			225,500	8,308	
Switzerland		336,398					1,382	4,358	
United Kingdom	4,536,574	175,449,512	31,713,323	1,958,092	12,888	870,509	1,049,690	1,499,122	
Other	36,260	35,565,237	12,794,928	63,755	804,670	869,256	11,218,746	17,888,127	
Total value	5,579,430 $935,604	822,453,924 $148,435,789	81,087,829 $14,584,737	37,635,489 $5,675,750	3,446,074 $967,462	6,322,719 $1,576,383	16,868,636 $3,332,229	25,080,448 $6,176,455	(2) $1,720,363

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[1] See text on preceding page.

[2] Figures for quantity not recorded.

Copper exported from the United States, 1920–1929

Year	Pounds		Total value
	Metallic[1]	Total	
1920	623,158,489	624,053,701	$127,468,606
1921	628,415,714	628,804,750	85,351,928
1922	742,755,957	743,039,888	103,874,007
1923	828,854,827	829,314,002	129,219,975
1924	1,116,775,136	1,116,915,484	156,645,684
1925	1,082,369,439	1,084,208,532	161,165,820
1926[2]	960,220,112	965,685,264	139,853,365
1927[2]	1,069,493,121	1,076,729,246	149,114,730
1928[2]	1,121,186,640	1,125,019,417	168,525,383
1929[2]	992,895,119	998,474,549	181,684,409

[1] Exclusive of ore, concentrates, and composition metal, and in 1923–1929 of unrefined copper, figures for which are not separable from those for ore and concentrates.

[2] Exclusive of "Other manufactures of copper," valued at $1,350,391 in 1926, $1,098,886 in 1927, $1,296,996 in 1928, and $1,720,363 in 1929; quantity not recorded.

Copper sulphate (blue vitriol) exported from the United States, 1920–1929

Year	Pounds	Value	Year	Pounds	Value
1920	3,783,409	$306,899	1925	6,139,344	$285,870
1921	3,582,933	217,491	1926	4,798,620	231,175
1922	5,250,556	256,432	1927	6,206,904	320,653
1923	2,290,905	130,213	1928	8,666,899	455,023
1924	2,988,039	142,626	1929	6,419,688	368,481

Brass and bronze exported from the United States, 1928 and 1929

	1928		1929	
	Pounds	Value	Pounds	Value
Ingots	84,826,337	$7,947,218	1,757,204	$267,639
Scrap and old			53,734,133	5,899,399
Bars and rods	1,994,683	394,545	3,573,820	756,159
Plates and sheets	2,409,043	510,885	2,296,693	573,960
Pipes and tubes	4,260,683	1,074,667	5,294,869	1,416,014
Pipe fittings and valves	4,042,351	2,076,033	4,591,222	2,466,041
Plumber's brass goods	968,952	540,566	1,077,489	636,058
Wire of brass or bronze	1,356,618	434,830	1,557,899	544,541
Brass wood screws	(1)	157,071	(1)	169,461
Hinges and butts of brass or bronze	(2)	(2)	(1)	94,169
Other hardware of brass or bronze	(1)	671,327	(1)	881,082
Other brass and bronze manufactures	(1)	3,810,737	(1)	3,798,554
		17,617,879		17,503,077

[1] Weight not recorded.

[2] Not separately classified prior to 1929.

Unmanufactured brass exported from the United States, 1920–1929

[Ingots,[1] bars, rods, plates, and sheets]

Year	Pounds	Value	Year	Pounds	Value
1920	5,810,733	$1,671,608	1925[1]	7,975,053	$1,359,594
1921	2,874,762	741,110	1926[1]	4,754,827	884,907
1922	3,660,340	635,449	1927[1]	3,511,299	648,853
1923	3,465,739	703,503	1928[1]	4,403,726	905,430
1924	4,529,257	740,993	1929	7,627,717	1,597,758

[1] Exclusive of ingots in 1925–1928, figures for which are not separable from those for "scrap and old."

CONSUMPTION

As calculated by the method shown in the following table, the quantity of new copper consumed in a year is actually the amount of new copper withdrawn from available supply on domestic account. This method of computation is not accurate, as figures on consumers' stocks are not available and can not be taken into account. In addition, much copper withdrawn on domestic account is later exported in manufactured forms. The domestic withdrawals in 1929 totaled 1,778,585,415 pounds. These withdrawals exceeded by 170,046,537 pounds those in 1928, the previous postwar record year.

New refined copper withdrawn from total year's supply on domestic account, 1922–1929, in pounds

	1922	1923	1924	1925	1926	1927	1928	1929
Total supply of new copper	1,358,659,101	2,140,546,843	2,405,985,978	2,304,347,370	2,493,051,142	2,429,042,791	2,572,338,409	2,874,127,168
Stock at beginning of year	459,000,000	216,000,000	264,000,000	243,000,000	124,000,000	146,000,000	171,000,000	114,000,000
Total available supply	1,817,659,101	2,356,546,843	2,669,985,978	2,547,347,370	2,617,051,142	2,575,042,791	2,743,338,409	2,988,127,168
Copper exported	[1] 705,025,268	[2] 792,073,512	[2] 1,072,243,414	[2] 1,022,335,279	[2] 900,914,935	[2] 981,083,572	[2] 1,020,799,531	[2] 903,541,753
Stock at end of year	216,000,000	264,000,000	243,000,000	124,000,000	146,000,000	171,000,000	114,000,000	306,000,000
	921,025,268	1,056,073,512	1,315,243,414	1,146,335,279	1,046,914,935	1,152,083,572	1,134,799,531	1,209,541,753
Withdrawn on domestic account	896,633,833	1,300,473,331	1,354,742,564	1,401,012,091	1,570,136,207	1,422,959,219	1,608,538,878	1,778,585,415

[1] Includes unrefined black blister and converter copper (bars, pigs, and other forms) and refined in ingots, bars, rods, or other forms.

[2] Includes refined copper in ingots, bars, rods, or other forms.

Adding the 1,253,100,000 pounds of secondary copper and copper in alloys produced during the year to the 1,778,600,000 pounds of new refined copper withdrawn on domestic account gives a total of about 3,031,700,000 pounds of new and old copper that was available for domestic consumption.

USES

No official data are available showing the quantity of copper that entered the different industries.

The following table shows the copper cast in different forms in 1929. It will be noted that the total is not the same as the production of refined copper.

Copper cast in different forms in the United States in 1929

Form	Pounds	Per cent
Wire bars	2,048,000,000	66.62
Cathodes	362,000,000	11.78
Cakes	338,000,000	10.99
Ingots	228,000,000	7.42
Other forms	98,000,000	3.19
	3,074,000,000	100.00

PRICES

Reports to the Bureau of Mines from copper-selling agencies in the United States indicate that 3,214,946,000 pounds of copper was delivered to domestic and foreign purchasers in 1929 at an average price of 17.6 cents per pound, or 3.2 cents per pound more than the average price obtained in 1928. The average price for copper in 1929 is above the average for the 20-year period ended in 1929.

Price per pound of copper, 1900–1929, in cents [7]

1900	16.6	1908	13.2	1916	24.6	1924	13.1
1901	16.7	1909	13.0	1917	27.3	1925	14.2
1902	12.2	1910	12.7	1918	24.7	1926	14.0
1903	13.7	1911	12.5	1919	18.6	1927	13.1
1904	12.8	1912	16.5	1920	18.4	1928	14.4
1905	15.6	1913	15.5	1921	12.9	1929	17.6
1906	19.3	1914	13.3	1922	13.5		
1907	20.0	1915	17.5	1923	14.7		

Average monthly prices at New York per pound of electrolytic copper, 1922–1929, in cents, as reported by the American Metal Market Co.

[F. o. b. refinery through August, 1927; thereafter, averages represent New York refinery equivalent]

Month	1922	1923	1924	1925	1926	1927	1928	1929
January	13.60	14.66	12.59	14.79	13.94	13.12	13.96	16.72
February	12.97	15.50	12.85	14.54	14.14	12.80	13.97	17.92
March	12.84	16.96	13.65	14.17	13.98	13.21	13.98	21.26
April	12.71	16.81	13.36	13.45	13.81	12.93	14.10	19.80
May	13.29	15.63	12.93	13.50	13.77	12.74	14.31	17.87
June	13.71	14.88	12.49	13.47	13.79	12.46	14.62	17.87
July	13.90	14.59	12.57	14.07	14.00	12.63	14.62	17.87
August	13.96	14.05	13.31	14.57	14.26	13.11	14.62	17.87
September	13.88	13.60	13.08	14.46	14.19	13.05	14.83	17.91
October	13.80	12.81	13.04	14.42	14.10	13.12	15.31	17.87
November	13.79	12.89	13.70	14.48	13.79	13.45	15.90	17.87
December	14.22	12.98	14.32	13.96	13.44	13.95	15.94	17.87
Average	13.56	14.61	13.16	14.16	13.93	13.05	14.68	18.23

Average monthly quoted prices at New York per pound of electrolytic copper, 1922–1929, in cents, as reported by the Engineering and Mining Journal

Month	1922	1923	1924	1925	1926	1927	1928	1929
January	13.465	14.510	12.401	14.709	13.822	12.990	13.854	16.603
February	12.864	15.355	12.708	14.463	13.999	12.682	13.823	17.727
March	12.567	16.832	13.515	14.004	13.859	13.079	13.845	21.257
April	12.573	16.663	13.206	13.252	13.706	12.808	13.986	19.500
May	13.111	15.440	12.772	13.347	13.599	12.621	14.203	17.775
June	13.575	14.663	12.327	13.399	13.656	12.370	14.527	17.775
July	13.654	14.321	12.390	13.946	13.924	12.532	14.527	17.775
August	13.723	13.822	13.221	14.490	14.174	12.971	14.526	17.775
September	13.748	13.323	12.917	14.376	14.062	12.940	14.724	17.775
October	13.632	12.574	12.933	14.300	13.862	12.958	15.202	17.775
November	13.598	12.727	13.635	14.353	13.576	13.319	15.778	17.775
December	14.074	12.823	14.260	13.866	13.302	13.774	15.844	17.775
Average	13.382	14.421	13.024	14.042	13.795	12.920	14.570	18.107

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[7] Weed, W. H., Copper Handbook: Vol. 11, pp. 1339, 1343, for years 1900 to 1903. U. S. Geological Survey computations for electrolytic copper since 1904. For 1916 and later years, average price all marketable grades.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN UTAH[1]

(MINE REPORT)

By C. N. Gerry[2]

SUMMARY

The output of gold, silver, copper, lead, and zinc from Utah mines in 1929 was valued at $95,985,201, an increase of $16,726,297 (21 per cent) over that in 1928; it was second only to the record value of $99,328,155, established in 1917. New production records were made in the output of copper and zinc, the gold output was the largest since 1907, the lead output was exceeded only by those of 1925 and 1927, and the silver output was exceeded by only four other years. The output of ore and the quantity of all five metals increased considerably over 1928, but the value of the silver decreased because of the decline in the price of the metal. The output of gold increased from $4,394,001 to $4,969,915, silver from 17,072,852 to 17,592,396 ounces, copper from 293,235,039 to 318,282,523 pounds, lead from 291,830,021 to 298,754,429 pounds, zinc from 93,857,352 to 103,019,485 pounds, and the total value from $79,258,904 to $95,985,201.

Compared with other States Utah was first in output of silver in 1929 (as it has been since 1920), second again in copper and lead, fourth in gold, and fifth again in zinc. Salt Lake County, which includes the Bingham district, again led in total value of metal output in 1929 as well as in production of gold, silver, copper, lead, and zinc. Utah County, which includes part of the Tintic district, was second in total value of the five metals, second in output of gold, silver, and lead, and fifth in output of copper. Wasatch County, which includes part of the Park City region, was third in the total value of the five metals, second in the output of zinc, third in the output of gold, and fourth in the output of silver, copper, and lead. Summit County, which includes the remainder of the Park City region, was fourth in the total value of the five metals, third in the output of silver, copper, lead, and zinc, and sixth in the output of gold.

Since 1864 Utah has yielded an output of the five metals as follows: Gold, $131,239,854; silver, 564,054,789 fine ounces; copper, 4,385,343,940 pounds; lead, 6,564,247,965 pounds; and zinc, 701,881,066 pounds. The total value of this output has been $1,706,500,148.

Published dividends paid by nine mining companies amounted to $38,167,339 in 1929, the largest amount ever paid in one year by mining companies in Utah. A recorded total of $351,010,003 has been paid to stockholders since mining became profitable in the State. In 1928 dividends paid by nine companies amounted to $18,307,894. Nearly 40 per cent (an unusually large part) of the total value of the metal output in 1929 was paid in dividends, and nearly 21 per cent of the metal output since 1864 has been paid in dividends.

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[1] Work on manuscript completed January, 1931.

[2] The valuable assistance of T. H. Miller and Paul Luff, of the Bureau of Mines, is acknowledged.

The dividends stated above for 1929 do not include $3,786,692 paid by the United States Smelting, Refining & Mining Co., which controls mines in other States and in Mexico besides those at Eureka and Bingham, Utah. The nine companies that contributed to the total dividends in 1929 were the Utah Copper, which paid more than 85 per cent of the total, Tintic Standard, Silver King Coalition, Park Utah Consolidated, North Lily, New Quincy, Utah-Apex, Bingham Mines, and Yankee Mines. The New Quincy Mining Co., operating property in the Park City region, paid its first dividend in 1929.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1920 to 1922 is New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1920	$1.09	$0.184	$0.080	$0.081	1925	$0.694	$0.142	$0.087	$0.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064
1923	.82	.147	.070	.068	1928	.585	.144	.058	.061
1924	.67	.131	.080	.065	1929	.533	.176	.063	.066

Mine production of gold, silver, copper, lead, and zinc in Utah, 1920-1929, in terms of recovered metals

Year	Mines producing		Ore, old tailings, etc. (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1920	161	3	6,800,180	97,454.15	$2,014,556	13,106,976	$14,286,604
1921	134	4	2,137,522	85,619.15	1,769,905	12,251,998	12,251,998
1922	147	7	5,560,034	111,110.36	2,296,855	17,271,100	17,271,100
1923	146	4	12,752,998	148,824.86	3,076,483	19,137,470	15,692,725
1924	136	2	13,640,618	146,486.85	3,028,152	17,253,692	11,559,974
1925	179	--------	14,479,247	177,803.08	3,675,516	21,276,689	14,766,022
1926	164	2	15,856,144	182,762.98	3,778,046	19,358,581	12,079,755
1927	123	--------	15,757,074	193,908.82	4,008,451	18,606,950	10,550,141
1928	121	3	18,427,117	212,559.79	4,394,001	17,072,852	9,987,618
1929	127	3	19,831,975	240,419.63	4,969,915	17,592,396	9,376,747

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1920	116,931,238	$21,515,348	140,838,113	$11,267,049	8,157,739	$660,777	$49,744,334
1921	30,891,403	3,984,991	89,187,269	4,013,427	69,390	3,469	22,023,790
1922	97,193,850	13,121,170	135,332,144	7,443,268	5,119,410	291,806	40,424,199
1923	222,393,572	32,691,855	203,447,793	14,241,346	11,330,913	770,502	66,472,911
1924	242,138,165	31,720,100	233,910,875	18,712,870	18,562,172	1,206,541	66,227,637
1925	236,486,540	33,581,089	306,669,824	26,680,275	52,611,732	3,998,492	82,701,394
1926	257,464,482	36,045,027	295,270,025	23,621,602	95,179,380	7,138,454	82,662,884
1927	256,933,278	33,658,259	302,570,040	19,061,913	99,185,443	6,347,868	73,626,632
1928	293,235,039	42,225,846	291,830,021	16,926,141	93,857,352	5,725,298	79,258,904
1929	318,282,523	56,017,724	298,754,429	18,821,529	103,019,485	6,799,286	95,985,201

GOLD

The production of gold in Utah in 1929, the largest since 1907, increased 13 per cent over that in 1928. Most of the gold came from Salt Lake, Utah, Wasatch, and Juab Counties, named in order of output. The gain was particularly notable in Salt Lake and Utah Counties and was due to the increased output of copper ore and siliceous gold ore. The decrease in the production of gold in Wasatch County was unusually large, especially from the Park Utah Consolidated property. There was, however, a good increase in gold from Tooele County, but a decrease from Piute County. Large increases in the output of gold were made by the Utah Copper, Eureka Standard, United States Smelting, Refining & Mining, Utah-Delaware, Centennial Eureka, North Lily, Niagara, and Bluestone Lime & Quartzite properties; large decreases were reported from the Park Utah Consolidated, Bingham Metals, Deer Trail, Eagle & Blue Bell, Mammoth tailings dump, and Live Yankee properties.

Almost all the gold produced in Utah in 1929 was recovered as a by-product from the smelting and refining of ore and concentrates. More than 57 per cent of the gold was derived from copper ore, nearly 16 per cent from lead-zinc ore, more than 11 per cent from lead ore, and nearly 15 per cent from siliceous ore. There was a marked increase in the quantity of gold derived from siliceous ore, chiefly from siliceous gold ore.

The Utah Copper property at Bingham was the largest producer of gold in Utah in 1929, accounting for nearly half the total output. The United States Smelting, Refining & Mining Co. (including the Bingham Mines Co.), operating properties at Bingham and Eureka, was second in gold output, and the Park Utah Consolidated Mines Co. at Park City was third. Other large producers of gold were the Eureka Standard, Utah-Delaware, North Lily, Utah-Apex, Eureka Lilly, Tintic Standard, Chief Consolidated, Bluestone Lime & Quartzite, Silver King Coalition, Niagara, Centennial Eureka, Mammoth, Utah Metal & Tunnel, and Live Yankee mines, named in order of output.

SILVER

In 1929 Utah was again the largest producer of silver in the United States, as it has been since 1920. The quantity increased 519,544 ounces over that of 1928, but the value decreased $610,871 owing to the decline in the price. The output was considerably less than the record of 21,276,689 ounces made in 1925, but it was nearly 5,000,000 ounces more than that of Montana, which ranked second as a producer of silver in the United States in 1929. Salt Lake County led in output, followed by Utah, Summit, Wasatch, and Juab Counties. The large increase in Salt Lake County offset the decreases in Summit, Wasatch, and Utah Counties; good increases were also made in Juab, Tooele, and Beaver Counties. The increase was especially notable in the Bingham district, Salt Lake County, and there was a slight increase in the Tintic district; however, a decrease of nearly 600,000 ounces was recorded in the Park City region. The output of many of the large producers decreased considerably, especially that of the Park Utah Consolidated Mines Co., the Ontario Silver Mining Co., and the Tintic Standard Mining Co. Good increases were made by the Bingham Prospect, New Quincy, Silve

King Coalition, Mammoth, Eureka Standard, Utah Copper, Chief Consolidated, Niagara, and Bluestone Lime & Quartzite companies. About 75 per cent of the silver output was recovered from lead ore and lead-zinc ore, more than 15 per cent was derived from siliceous ore, and more than 9 per cent came from copper ore. No refined silver was produced in Utah, as the entire output was recovered at eastern plants from bullion produced at smelters near Salt Lake City.

Eleven properties in Utah each produced more than 500,000 ounces of silver in 1929. These were the Silver King Coalition in the Park City region; the Tintic Standard in the Tintic district; the Park Utah Consolidated in the Park City region; the United States Smelting, Refining & Mining Co. (including property of the Bingham Mines Co.), operating properties at Bingham and in the Tintic district; the Utah Copper and the Bingham Prospect in the Bingham district; the North Lily and the Chief Consolidated in the Tintic district; the New Quincy at Park City; and the Plutus and Mammoth mines in the Tintic district.

COPPER

In 1929 Utah again ranked second among the States as a producer of copper, and the output was the largest ever recorded for the State. In quantity the output increased 25,047,484 pounds (nearly 9 per cent) over that in 1928, and the value increased nearly $14,000,000 (nearly 33 per cent), owing to the advanced price of the metal. The Utah Copper Co. increased its copper output more than 8 per cent in 1929 and was the largest single producer of copper in the United States, exceeding even the output of the group of copper mines at Butte worked by the Anaconda Copper Mining Co. Nearly 98 per cent of the copper produced in Utah came from the Bingham or West Mountain district, Salt Lake County, and more than 95 per cent of the copper from this district was produced by the Utah Copper Co. The output of copper from the Tintic district, Juab and Utah Counties, and of the Park City region, Summit and Wasatch Counties, was comparatively small.

Crude ore shipped to smelters yielded 11,454,902 pounds of copper, compared with 8,967,039 pounds in 1928. Of the copper from crude copper ore smelted 7,055,148 pounds came from sulphide ores and 658,534 pounds from oxidized ores; of the lead ores smelted sulphide ores yielded 761,312 pounds of copper and oxidized ores 808,300 pounds. The copper-lead ores smelted were chiefly sulphide and yielded 15,678 pounds of copper. The dry and siliceous ore, used chiefly as a flux at smelting plants, yielded 2,155,930 pounds of copper, compared with 1,885,727 pounds in 1928. The low-grade disseminated ores that were concentrated yielded 292,205,094 pounds of copper, compared with 271,910,945 pounds in 1928. About 97 per cent of the recovered copper came from copper ore, nearly all of which was treated by concentration.

The leading copper producers in Utah in 1929 were, in order of output, the Utah Copper Co. (which reported 296,625,554 net pounds, the largest production the company has ever made and an increase from 273,823,351 net pounds reported in 1928), Utah-Delaware, Utah-Apex, United States Smelting, Refining & Mining (including Bingham Mines Co.), Ohio Copper, Silver King Coalition, Chief Consolidated, Mammoth, Park Utah Consolidated, and Tintic Standard properties. Good increases in the output of copper were made by the Utah Copper, Utah-Delaware, and United States Smelting, Refining & Mining companies. The total output of copper from mine-water precipitates and from ore leached in place was greatly increased as a result of the operation of the new precipitation plant of the Utah Copper Co. at the mouth of Bingham Canyon. In addition to development from the Mascotte tunnel at Lark the Ohio Copper Co. continued to leach in place the caved area of the mine; the yield of copper from precipitates or cement copper from this source, however, was considerably less than that of 1928.

LEAD

In 1929 Utah again ranked second among the States as a producer of lead, following Missouri. The output increased from 291,830,021 pounds in 1928 to 298,754,429 pounds in 1929, or more than 2 per cent. The 1929 output has been exceeded only by that of two other years, 1925 with 306,669,824 pounds and 1927 with 302,570,040 pounds. Nearly 53 per cent of the lead in 1929 came from lead-zinc ore and 44 per cent came from lead ore.

The output of lead from the Bingham or West Mountain district decreased from 104,750,662 pounds in 1928 to 98,894,016 pounds in 1929; most of the lead output at Bingham came from the property of the United States Smelting, Refining & Mining Co. (including Bingham Mines Co.), the Utah-Apex, Utah-Delaware, Utah Copper, and Bingham Prospect properties. Decided increases in lead output were made by the Bingham Prospect, Utah Copper Co., and United States Smelting, Refining & Mining Co., but unusually large decreases from the Utah-Delaware and Utah-Apex mines more than offset these gains, resulting in a decided decrease in the output of the district. The increase in the lead output of the Bingham Prospect mine at Lark was notable.

The output of lead from the Tintic district (Juab and Utah Counties) increased slightly—from 88,192,591 pounds in 1928 to 88,226,699 pounds in 1929. The increased production of lead from mines in the eastern section of the district in Utah County offset the decreased output from mines in the western section in Juab County. Large decreases were made by the Plutus, Eureka Lilly, and Eagle & Blue Bell mines, but good increases were recorded from the North Lily, Chief Consolidated, Victoria, Bullion Beck & Champion, and Mammoth properties. The output of the Tintic Standard Mining Co. decreased slightly.

The production of lead in the Park City region (Summit and Wasatch Counties) increased from 82,854,090 pounds in 1928 to 85,139,968 pounds in 1929. There was a decided decrease in the output of lead from the properties of the Park Utah Consolidated Mines Co., but this decrease was more than offset by the large increases from the Silver King Coalition and New Quincy mines.

There was a decided increase in the output of lead from the Rush Valley district, Tooele County—from 14,443,351 pounds in 1928 to 23,502,937 pounds in 1929—due in large part to increased shipments of lead ore from the Cyclone-Tip Top property at Bauer, operated by the Bluestone Lime & Quartzite Mining Co. The output of lead from the Honerine mine of the Combined Metals Reduction Co., chiefly from lead-zinc ore, also increased.

The output of lead from Beaver County increased from 668,332 to 2,118,175 pounds, owing to active mining at the Horn Silver and Moscow mines. The combined production of the Big and Little Cottonwood districts increased from 292,975 to 346,381 pounds.

The United States Smelting, Refining & Mining Co. (including Bingham Mines Co.), operating properties in the Bingham and Tintic districts, ranked first in lead output in Utah in 1929. It was followed in order by the Silver King Coalition mine in the Park City region, the Tintic Standard property (including the Iron Blossom mine) in the Tintic district, the Park Utah Consolidated property in the Park City region, and the North Lily mine in the Tintic district. Each of these was credited with a production of more than 30,000,000 pounds of lead. Other large producers of lead were the Utah-Apex, Utah-Delaware, Bluestone Lime & Quartzite, Utah Copper, Combined Metals, New Quincy, Chief Consolidated, and Bingham Prospect properties.

ZINC

The production of zinc in Utah in 1929 was the largest ever recorded in the State; it exceeded by nearly 4,000,000 pounds the former record output of 99,185,443 pounds made in 1927. Compared with other States Utah ranks fifth in zinc production, following Oklahoma, Kansas, New Jersey, and Montana. The output increased from 93,857,352 pounds in 1928 to 103,019,485 pounds in 1929, or nearly 10 per cent.

The Park City region, Summit and Wasatch Counties, and the Bingham or West Mountain district, Salt Lake County, were the chief zinc-producing areas in Utah. The output of zinc from the Park City region increased from 47,569,849 to 55,929,712 pounds. Notable increases in the production of zinc from the Silver King Coalition and New Quincy mines more than offset large decreases recorded from the Park Utah Consolidated and Ontario properties and resulted in an increase of more than 8,000,000 pounds from the famous region near Park City.

The output from the Bingham or West Mountain district, Salt Lake County, decreased from 44,492,643 to 43,588,545 pounds. Although increased zinc production was made by the United States Smelting, Refining & Mining Co., Bingham Prospect, Utah Metal & Tunnel, and Niagara properties, these gains were not sufficient to balance the decreases from the Utah-Delaware and Utah-Apex properties.

The large increase in the output of zinc in Beaver County was due to regular shipments of lead-zinc milling ore from the Horn Silver mine, and the decline recorded in Tooele County was due to the decrease in the output of lead-zinc ore from the property of the Combined Metals Reduction Co. at Bauer.

The Park Utah Consolidated Mines Co., operating in the Park City region, again ranked first in zinc output in Utah in 1929, followed by the mines of the United States Smelting, Refining & Mining Co. at Bingham and the Silver King Coalition mine at Park City; each of these produced more than 14,000,000 pounds of zinc. Other large zinc producers were the New Quincy, Utah-Apex, Utah-Delaware, Utah Metal & Tunnel, Utah Copper, Bingham Prospect, Horn Silver, and Combined Metals properties.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1929, by counties, in terms of recovered metals

County	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value
Beaver	235.30	$4,864	72,060	$38,408
Box Elder			88	47
Grand	4.26	88	2	1
Juab	14,079.64	291,052	2,496,199	1,330,474
Millard	.05	1	13	7
Piute	937.41	19,378	7,955	4,240
Salt Lake	161,027.21	3,328,728	4,675,321	2,491,946
San Juan	41.02	848	88	47
Sevier				
Summit	3,953.50	81,726	3,371,426	1,796,970
Tooele	6,541.36	135,222	387,441	206,506
Uintah	1.98	41	28	15
Utah	36,789.86	760,514	3,795,685	2,023,100
Wasatch	16,768.61	346,638	2,786,075	1,484,978
Washington	39.43	815	15	8
	240,419.63	4,969,915	17,592,396	9,376,747
Total, 1928	212,559.79	4,394,001	17,072,852	9,987,618

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaver	76,477	$13,460	2,118,175	$133,445	1,288,591	$85,047	$275,224
Box Elder	20,205	3,556	8,238	519			4,122
Grand							89
Juab	2,446,000	430,496	18,014,746	1,134,929	492,803	32,525	3,219,476
Millard			3,349	211			219
Piute	5,443	958	19,667	1,239			25,815
Salt Lake	311,950,443	54,903,278	99,242,873	6,252,301	43,675,758	2,882,600	69,858,853
San Juan	51,773	9,112					10,007
Sevier			683	43	25,652	1,693	1,736
Summit	1,589,801	279,805	44,086,667	2,777,460	16,460,364	1,086,384	6,022,345
Tooele	329,750	58,036	23,599,238	1,486,752	1,048,727	69,216	1,955,732
Uintah	5,898	1,038					1,094
Utah	790,733	139,169	70,607,492	4,448,272	558,242	36,844	7,407,899
Wasatch	934,523	164,476	41,053,301	2,586,358	39,469,348	2,604,977	7,187,427
Washington	81,477	14,340					15,163
	318,282,523	56,017,724	298,754,429	18,821,529	103,019,485	6,799,286	95,985,201
Total, 1928	293,235,039	42,225,846	291,830,021	16,926,141	93,857,352	5,725,298	79,258,904

Ore, old tailings, etc., sold or treated, lode mines producing, and average value of ore, etc., in gold and silver in Utah, 1928 and 1929, by counties

County	Ore, old tailings, etc. (short tons)		Lode mines producing		Average value per ton in gold and silver	
	1928	1929	1928	1929	1928	1929
Beaver	2,810	10,062	6	10	$7.06	$4.30
Box Elder	70	144	3	3	.56	.33
Juab	170,477	207,991	21	24	9.59	7.80
Millard	223	5	1	1	.96	1.60
Piute	6,475	2,552	3	5	13.26	9.25
Salt Lake	17,253,593	18,517,039	33	28	.30	.31
San Juan		362		1		.17
Sanpete	13		2		1.62	
Sevier		43		1		
Summit	399,082	452,398	9	6	5.63	4.15
Tooele	48,716	62,630	25	24	4.89	5.46
Uintah		10		1		1.50
Utah	213,631	253,086	12	16	13.09	11.00
Wasatch	332,021	325,511	5	5	6.75	5.63
Washington	6	142	1	2	66.17	5.80
	18,427,117	19,831,975	121	127	.78	.72

MINING INDUSTRY

The mining industry in Utah in 1929 enjoyed an unusually profitable year. The average price of copper, which was distinctly increased, greatly stimulated the production of copper ore and resulted in an increase of nearly 33 per cent in the value of recovered copper, as well as large increases in the production of the associated gold and silver. Substantial increases were also made in the production of lead and zinc. Dividends disbursed were the largest ever paid in the State and represented nearly 40 per cent of the value of the five metals produced. The electrification program at the property of the Utah Copper Co. was completed in 1929, and the expenditure for this purpose was the largest made for mine improvement in the State during the year. The Tintic Standard Mining Co. completely rebuilt the surface plant at the property of the Eureka Standard Mining Co., which is now in a position to handle its entire output at a substantial saving. One of the outstanding events of the year was the acquisition by the United States Smelting, Refining & Mining Co. of the entire holdings of the Bingham Mines Co., which gives the former company control of many properties in both the Bingham or West Mountain and Tintic districts. In addition to its usual milling and smelting activities near Tooele the International Smelting Co. did extensive exploration during the year through newly organized companies operating near Keetley and Eureka. The Park Premier Mining Co. worked a large group of claims in the eastern section of the Park City region, and the North Lily Knight Mining Co. was organized to control a large acreage in the Tintic district. The American Smelting & Refining Co. also did considerable exploration on property in various districts and secured properties in the Ophir-Dry Canyon section of Tooele County, the American Fork district of Utah County, and the eastern part of the Park City region. The output of Beaver County was increased greatly by the work of the Tintic Lead Co., which continued to rehabilitate the Horn Silver mine at Frisco.

ORE CLASSIFICATION

Ore, old tailings, etc., sold or treated in Utah, 1920–1929, with content in terms of recovered metals

DRY AND SILICEOUS ORE

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1920	291,020	33,347.99	3,955,771	2,116,803	6,282,276	------------
1921	376,472	29,554.10	6,088,635	1,371,654	8,735,063	------------
1922	414,339	38,353.62	8,110,733	2,635,080	8,693,250	------------
1923	346,425	32,714.51	6,737,300	2,852,586	6,358,703	------------
1924	282,226	27,098.75	4,749,144	1,998,016	7,137,005	------------
1925	389,030	34,269.82	4,434,524	3,926,172	10,134,106	------------
1926	301,213	24,097.08	3,365,644	2,970,610	6,408,867	------------
1927	245,344	22,709.99	2,577,357	3,072,539	5,713,355	------------
1928	211,758	25,573.78	2,355,975	2,293,800	5,705,697	------------
1929	255,192	36,172.76	2,714,111	2,506,637	6,564,788	------------
COPPER ORE						
1920	5,778,373	31,845.51	452,915	[1] 108,645,375	31,461	------------
1921	1,357,857	14,384.74	229,556	[1] 27,321,481	255,567	------------
1922	4,509,384	36,398.64	473,284	[1] 91,088,007	252.970	------------
1923	11,519,727	84,203.12	867,618	[1] 214,305,888	30,852	------------
1924	12,357,366	83,444.56	887,541	[1] 234,954,343	199,275	------------
1925	12,575,265	87,168.24	[1] 959,790	[1] 223.484,426	701,063	------------
1926	13,949,866	100,853.65	1,281,767	[1] 245,328,789	582,261	------------
1927	13,879,173	100,057.71	[1] 1,138,014	[1] 244,279,301	242,552	------------
1928	16,631,757	115,164.28	1,275,682	[1] 282,899,020	317,511	------------
1929	17,895,332	137,353.04	1,608,570	[1] 308,131,613	891,998	------------

[1] Includes metal saved from precipitates.

Ore, old tailings, etc., sold or treated in Utah, 1920–1929, with content in terms of recovered metals—Continued

LEAD ORE

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1920	559,896	18,185.95	7,895,007	4,961,482	111,133,846	
1921	401,429	41,628.44	5,893,497	2,088,255	79,519,436	69,390
1922	507,450	17,853.25	8,183,741	2,945,328	107,416,311	
1923	645,991	21,365.84	10,648,952	4,494,047	168,875,684	16,535
1924	729,219	24,380.08	9,936,956	4,138,013	179,798,884	403,789
1925	699,361	27,002.58	10,318,309	5,874,744	185,821,166	
1926	383,857	19,095.25	7,307,599	4,038,262	130,674,816	
1927	337,734	19,868.69	7,214,271	2,665,402	131,088,261	
1928	341,194	26,727.17	6,241,616	2,430,055	134,193,203	
1929	374,802	27,422.01	5,281,243	1,829,406	131,738,786	

COPPER-LEAD ORE

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
1920	6,389	223.78	172,401	407,397	2,155,329	
1921	1,764	31.84	40,309	110,013	677,203	
1922	1,272	35.14	20,919	125,233	137,399	
1923	971	24.96	30,924	90,624	164,495	
1924	19	1.76	462	5,257	3,294	
1925	13	.04	55	1,370	1,924	
1926						
1927	73,878	1,016.36	169,111	2,218,716	3,902,896	
1928	45,365	1,632.79	94,304	1,194,110	2,905,485	
1929	44,219	1,187.55	75,574	883,605	1,928,980	

ZINC ORE AND LEAD-ZINC ORE[2]

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
1920	164,502	13,829.01	630,875	800,181	21,235,201	8,157,739
1921						
1922	127,589	18,366.67	482,417	400,202	18,832,214	5,119,410
1923	239,884	10,490.94	852,673	650,427	28,018,059	11,314,378
1924	271,788	11,550.48	1,679,588	1,042,536	46,772,417	18,158,383
1925 [2]	815,578	29,362.40	5,564,011	3,199,828	110,011,565	52,611,732
1926	1,221,208	38,700.84	7,403,570	5,126,821	157,604,081	95,179,380
1927	1,220,945	50,256.07	7,508,197	4,697,320	161,622,976	99,185,443
1928	1,197,043	43,415.77	7,105,269	4,418,054	148,708,125	93,857,352
1929	1,262,430	38,238.02	7,912,883	4,931,262	157,629,877	103,019,485

[2] Includes copper-lead-zinc ore in 1925 as follows: 563 tons, yielding 5.07 ounces of gold, 3,957 ounces of silver, 10,194 pounds of copper, 136,737 pounds of lead, and 212,159 pounds of zinc.

Ore, old tailings, etc., sold or treated in Utah in 1929, with content in terms of recovered metals

Source	Mines producing	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	9	25,564	20,561.46	212,701	79,139	261,482	
Dry gold and silver ore	14	[1] 55,001	7,331.56	289,458	857,903	596,883	
Dry silver ore	33	[2] 174,627	8,279.74	2,211,952	1,569,595	5,706,423	
Copper ore	37	17,895,332	137,353.04	1,608,570	[3] 308,131,613	891,998	
Lead ore	64	[4] 374,802	27,422.01	5,281,243	1,829,406	131,738,786	
Zinc ore	1	43				683	25,652
Copper-lead ore	5	[5] 44,219	1,187.55	75,574	883,605	1,928,980	
Lead-zinc ore	27	[6] 1,262,387	38,238.02	7,912,883	4,931,262	157,629,194	102,993,833
Total, lode mines	[7] 127	19,831,975	240,373.38	17,592,381	[3] 318,282,523	298,754,429	103,019,485
Total, placers	3		46.25	15			
	130	19,831,975	240,419.63	17,592,396	[3] 318,282,523	298,754,429	103,019,485
Total, 1928	124	18,427,117	212,559.79	17,072,852	[8] 293,235,039	291,830,021	93,857,352

[1] Includes 11,915 tons of old tailings sold to a smelter.
[2] Includes 49,213 tons of old tailings and 108 tons of old slag sold to a smelter.
[3] Includes 6,812,905 pounds of copper saved from precipitates.
[4] Includes 11 tons of old tailings sold to a smelter.
[5] Includes 72 tons of old tailings and 12 tons of old matte sold to a smelter.
[6] Includes 250,000 tons of old tailings concentrated.
[7] A mine producing more than one class of ore is counted but once in arriving at a total for all classes.
[8] Includes 6,207,777 pounds of copper saved from precipitates.

Value of metals from ore, old tailings, etc., sold or treated in Utah in 1929, by classes of ore

Class	Ore, old tailings, etc. (short tons)	Gold	Silver	Copper	Lead	Zinc	Total
Dry gold ore	25, 564	$425, 043	$113, 370	$13, 928	$16, 473	----------	$568, 814
Dry gold and silver ore	55, 001	151, 557	154. 281	150, 991	37, 604	----------	494, 433
Dry silver ore	174, 627	171, 157	1, 178, 970	276, 249	359, 505	----------	1, 985, 881
Copper ore	17, 895, 332	2, 839, 340	857, 368	[1] 54, 231, 164	56, 196	----------	[1] 57, 984, 068
Lead ore	374, 802	566, 863	2, 814, 902	321, 975	8, 299, 543	----------	12, 003, 283
Zinc ore	43	----------	----------	----------	43	$1, 693	1, 736
Copper-lead ore	44, 219	24, 549	40, 281	155, 515	121, 526	----------	341, 871
Lead-zinc ore	1, 262, 387	790, 450	4, 217, 567	867, 902	9, 930, 639	6, 797, 593	22, 604, 151
	19, 831, 975	4, 968, 959	9, 376, 739	[1] 56, 017, 724	18, 821, 529	6, 799, 286	95, 984, 237
Total, 1928	18, 427, 117	4, 393, 050	9, 987, 614	[2] 42, 225, 846	16, 926, 141	5, 725, 298	79, 257, 949

[1] Includes value of 6,812,905 pounds of copper saved from precipitates.
[2] Includes value of 6,207,777 pounds of copper saved from precipitates.

GOLD ORE

Nine mines produced 25,564 tons of siliceous gold ore in 1929, compared with eight mines which produced 14,704 tons of similar material in 1928. The metals recovered from gold ore were valued at $568,814, an average of $22.25 a ton. The output of ore yielded on the average 0.80 ounce of gold and 8.32 ounces of silver to the ton and a little copper and lead. Nearly 72 per cent of the gold ore was mined from the Eureka Standard property near Dividend, in the eastern part of the Tintic district. Other large producers of gold ore were the Eureka Lilly and Deer Trail mines.

GOLD AND SILVER ORE

Fourteen mines produced 55,001 tons of siliceous gold and silver ore and old tailings in 1929, compared with nine mines which produced 36,063 tons of similar material in 1928. In 1929 the ore and old tailings yielded on the average 0.13 ounce of gold and 5.26 ounces of silver to the ton, 0.78 per cent of copper, and 0.54 per cent of lead; the recovered metals were valued at $494,433, an average of $8.99 a ton. Two properties in the Tintic district, Juab County—the Centennial Eureka and the Chief Consolidated—produced 64 per cent of the gold and silver material. Most of the remainder was old tailings from the Mammoth dump; there was a marked decrease in the quantity of these old tailings shipped in 1929.

SILVER ORE

Dry and siliceous silver ore, old tailings, etc., were produced by 33 mines in 1929, compared with 32 in 1928. The material increased from 160,991 to 174,627 tons and yielded on the average $0.98 in gold, 12.67 ounces of silver, 8.99 pounds of copper, and 32.68 pounds of lead to the ton. The metals recovered from the ore, old tailings, etc., were valued at $1,985,881, an average of $11.37 a ton. Twenty-one mines and dumps in the Tintic district in Juab and Utah Counties produced 152,686 tons of silver ore and other material or 87 per cent of the total. The largest producers of this class of material were the Tintic Standard (including shipments from the dump of the Harold mill), Chief Consolidated (including old tailings), Mammoth, Bullion Beck & Champion (including old tailings), and Plutus properties.

COPPER ORE

The output of copper ore increased nearly 8 per cent in 1929 and represented 90 per cent of the State total. The ore yielded on the average 0.0077 ounce of gold, 0.09 ounce of silver, 16.838 pounds of copper, and a little lead to the ton; the recovered metals were valued at $56,784,997, an average of $3.17 a ton. This value represents 59 per cent of the total value of the metal output of the State. Salt Lake County produced nearly all the copper ore, chiefly from the Utah Copper property at Bingham. Other leading producers of copper ore were the properties of the Utah-Delaware, Utah-Apex, and United States Smelting, Refining & Mining Co., also at Bingham.

LEAD ORE

The metals recovered from lead ore and a small quantity of old tailings produced by 64 properties in 1929 were valued at $12,003,283, an average of $32.03 a ton, compared with 82 producers and $12,336,979 in 1928. The lead ore and old tailings, which represented 2 per cent of the total output of the State, increased nearly 10 per cent in 1929 and yielded on the average 0.073 ounce of gold and 14.09 ounces of silver to the ton, 0.244 per cent of copper, and 17.574 per cent of lead. Nearly 57 per cent of this material was produced from 17 mines in the Tintic district, 27 per cent was produced from 14 mines in the Bingham district, and most of the remainder came from 2 properties in the Rush Valley district, Tooele County. Unusually large increases in the output of lead ore were made from the North Lily, Utah-Delaware, Bluestone Lime & Quartzite, Bingham Prospect, Utah Copper, and Chief Consolidated properties, but large decreases were reported from the Silver King Coalition, Plutus, Eureka Lilly, and Dalton & Lark (United States Smelting, Refining & Mining Co.) properties.

The two largest producers of lead ore in Utah in 1929 were the Tintic Standard and North Lily mines at Dividend in the Tintic district. They were followed in order by the Utah-Delaware mine at Bingham, the Bluestone Lime & Quartzite Mining Co. at Bauer in the Rush Valley district, the Utah Copper property at Bingham, the Combined Metals Reduction Co. at Bauer in the Rush Valley district, the Chief Consolidated property in the Tintic district, the property of the United States Smelting, Refining & Mining Co. (including Bingham Mines Co.) at Bingham, the Plutus mine in the Tintic district, the Bingham Prospect property at Lark in the Bingham district, and the Eureka Lilly mine in the Tintic district.

COPPER-LEAD ORE

Five properties in 1929 produced copper-lead ore which, together with a small quantity of old tailings and old smelter matte, yielded on the average 0.027 ounce of gold and 1.71 ounces of silver to the ton, 1 per cent of copper, and 2.18 per cent of lead. The metals recovered from the ore, old tailings, and matte were valued at $341,871, an average of $7.73 a ton. Nearly all the copper-lead ore was produced from the Utah-Apex mine at Bingham.

LEAD-ZINC ORE

Lead-zinc ore and old tailings produced nearly all the zinc recovered from Utah mines in 1929. The output of this material, which represented more than 6 per cent of the total output of ore and other material of the State, increased from 1,197,043 to 1,262,387 tons and yielded on the average 0.03 ounce of gold and 6.27 ounces of silver to the ton, 0.195 per cent of copper, 6.243 per cent of lead, and 4.08 per cent of zinc. The metals recovered from the ore and old tailings were valued at $22,604,151, an average of $17.91 a ton. More than 60 per cent of the material came from 8 mines in the Park City region and nearly 38 per cent from 12 mines in the Bingham or West Mountain district. There was a decided increase in the output of lead-zinc ore from the Park City region but a decrease from the Bingham district. The large increase in the output of lead-zinc ore from the Silver King Coalition and New Quincy mines at Park City offset the decrease from the Park Utah Consolidated property. In the Bingham district large decreases were made by the Utah-Delaware, Park Bingham, and Utah-Apex mines, but good increases were recorded by the United States Smelting, Refining & Mining Co. (including Bingham Mines Co.), and at the Bingham Prospect, Niagara, Utah Metal & Tunnel, and Utah Copper properties. Most of the output from the Bingham or West Mountain and Park City districts was concentrated at the custom flotation plants at Midvale, Bauer, and International, where ore from Utah and neighboring States was treated at the rate of more than 2,300 tons a day. Most of the zinc product from lead-zinc ore was shipped to the electrolytic zinc plants at Anaconda and Great Falls, Mont., but some of it went to Amarillo, Tex. The largest producers of lead-zinc ore in Utah in 1929 were the Park Utah Consolidated mines in the Park City region, the property of the United States Smelting, Refining & Mining Co. (including Bingham Mines Co.) at Bingham, the Silver King Coalition mine at Park City, the Utah-Apex and Utah-Delaware mines, both at Bingham, the New Quincy mine at Park City, and the Utah Metal & Tunnel and Utah Copper properties, both at Bingham. A large quantity of old tailings from Park City was also reconcentrated.

ZINC ORE

A car of oxidized zinc ore from the property of the Salina Lead-Zinc Co., near Redmond, in Sevier County, was shipped to an eastern zinc plant.

Ore, old tailings, etc., sold or treated in Utah in 1929, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Piute	2,085	861.41	5,015	3,267	6,000	----------
Salt Lake	216	101.52	1,236	1,557	----------	----------
Tooele	84	437.29	27	120	34	----------
Utah	23,177	19,121.81	206,408	74,195	255,448	----------
Washington	2	39.43	15	----------	----------	----------
	25,564	20,561.46	212,701	79,139	261,482	----------
Total, 1928	14,704	8,700.95	75,023	86,114	253,032	----------

Ore, old tailings, etc., sold or treated in Utah in 1929, by counties, with content in terms of recovered metals—Continued

DRY GOLD AND SILVER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	338	60.79	3,396	980	4,000	----------
Juab	[1] 50,673	6,440.13	243,086	823,031	447,770	----------
Piute	[2] 461	75.00	2,846	2,102	12,000	----------
Salt Lake	1,234	368.89	20,217	6,926	46,613	----------
Utah	[3] 2,295	386.75	19,913	24,864	86,500	----------
	55,001	7,331.56	289,458	857,903	596,883	----------
Total, 1928	36,063	7,848.56	189,252	647,808	286,859	----------

DRY SILVER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Beaver	334	21.65	2,576	8,338	----------	----------
Juab	[4] 88,598	4,670.35	1,011,300	991,806	2,514,954	----------
Salt Lake	[5] 11,244	344.71	124,369	204,390	661,619	----------
Summit	[6] 5,956	171.00	151,929	38,870	143,000	----------
Tooele	98	3.24	2,610	1,218	651	----------
Utah	[7] 64,088	2,844.52	832,566	314,036	2,317,809	----------
Wasatch	4,309	224.27	86,602	10,937	68,390	----------
	174,627	8,279.74	2,211,952	1,569,595	5,706,423	----------
Total, 1928	160,991	9,024.27	2,091,700	1,559,878	5,165,806	----------

COPPER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Beaver	395	9.92	1,131	35,748	1,000	----------
Box Elder	101	----------	54	20,205	----------	----------
Juab	7,086	482.61	114,581	426,453	243,000	----------
Salt Lake	17,883,384	135,157.22	1,482,353	[8] 307,392,141	624,500	----------
San Juan	362	1.01	75	51,773	----------	----------
Tooele	486	46.27	2,140	51,052	5,000	----------
Uintah	10	----------	28	5,898	----------	----------
Utah	3,368	1,656.01	8,208	66,866	18,498	----------
Washington	140	----------	----------	81,477	----------	----------
	17,895,332	137,353.04	1,608,570	[8] 308,131,613	891,998	----------
Total, 1928	16,631,757	115,164.28	1,275,682	[9] 282,899,020	317,511	----------

LEAD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Beaver	3,208	97.47	30,980	13,580	1,164,681	----------
Box Elder	43	----------	34	----------	8,238	----------
Juab	58,191	2,417.92	1,102,422	199,556	14,407,129	----------
Millard	5	.05	13	----------	3,349	----------
Piute	6	1.00	94	74	1,667	----------
Salt Lake	[10] 100,330	6,132.68	1,006,117	1,017,350	25,421,598	----------
Summit	1,770	50.50	30,926	13,098	517,675	----------
Tooele	53,087	5,958.49	360.334	256,319	22,517,685	----------
Utah	157,107	12,694.17	2,716,794	309,796	67,358,573	----------
Wasatch	1,055	69.73	33,529	19,633	338,191	----------
	374,802	27,422.01	5,281,243	1,829,406	131,738,786	----------
Total, 1928	341,194	26,727.17	6,241,616	2,430,055	134,193,203	----------

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[1] Includes 11,400 tons of old tailings sold to a smelter.
[2] Includes 429 tons of old tailings sold to a smelter.
[3] Includes 86 tons of old tailings sold to a smelter.
[4] Includes 22,422 tons of old tailings sold to a smelter.
[5] Includes 120 tons of old tailings sold to a smelter.
[6] Includes 1,156 tons of old tailings sold to a smelter.
[7] Includes 25,515 tons of old tailings and 108 tons of old slag sold to a smelter.
[8] Includes 6,812,905 pounds of copper saved from precipitates.
[9] Includes 6,207,777 pounds of copper saved from precipitates.
[10] Includes 11 tons of old tailings sold to a smelter.

Ore, old tailings, etc., sold or treated in Utah in 1929, by counties, with content in terms of recovered metals—Continued

COPPER-LEAD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Salt Lake	[11] 44,087	1,182.44	74,336	876,605	1,910,039	----------
Summit	[12] 72	2.88	563	4,000	7,000	----------
Tooele	60	2.23	675	3,000	11,941	----------
	44,219	1,187.55	75,574	883,605	1,928,980	----------
Total, 1928	45,365	1,632.79	94,304	1,194,110	2,905,485	----------

LEAD-ZINC ORE

Beaver	5,787	45.47	33,977	17,831	948,494	1,288,591
Juab	3,443	68.63	24,810	5,154	401,893	492,803
Salt Lake	476,544	17,739.75	1,966,693	2,451,474	70,578,504	43,675.758
Summit	[13] 444,600	3,729.12	3,188,008	1,533,833	43,418,992	16,460,364
Tooele	8,815	93.84	21,655	18,041	1,063,927	1,048,727
Utah	3,051	86.60	11,796	976	570,664	558,242
Wasatch	320,147	16,474.61	2,665,944	903,953	40,646,720	39,469,348
	1,262,387	38,238.02	7,912,883	4,931,262	157,629,194	102,993,833
Total, 1928	1,197,043	43,415.77	7,105,269	4,418,054	148,708,125	93,857,352

[11] Includes 12 tons of old matte sold to a smelter.
[12] Old tailings sold to a smelter.
[13] Includes 250,000 tons of old tailings concentrated.

Zinc products (as marketed from Utah mines and mills) sold to smelters and electrolytic plants in 1929

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore or concentrates	Recovered zinc
		Short tons	*Pounds*	*Per cent*	*Pounds*
Oxidized zinc ore	Sevier	43	28,221	32.82	25,652
Oxidized lead-zinc ore	Beaver	35	13,240	18.91	11,250
Zinc concentrates	Beaver, Juab, Salt Lake, Summit, Tooele, Utah, and Wasatch.	105,389	113,299,803	53.75	102,715,959
Lead-zinc concentrates	Salt Lake and Wasatch	291	302,295	51.94	266,624
		105,758	113,643,559	53.73	103,019,485
Total, 1928	----------	99,593	106,836,658	53.64	93,857,352

METALLURGIC INDUSTRY

In 1929 most of the ore and old tailings (96.87 per cent) from Utah mines was concentrated; the resulting concentrates, with the first-class shipping ore, old tailings, precipitates, etc., were smelted and yielded metals valued at $95,983,414. The only ore amalgamated was 2 tons of gold ore; it yielded bullion containing gold and silver valued at $823. In the last decade Utah has become an important smelting center, but no refining is done in the State. Large custom copper plants are operated at Garfield and International and lead plants at Midvale, Murray, and International; these smelters are discussed under Salt Lake and Tooele Counties.

The milling practice in Utah has improved steadily, especially the development of flotation at the large mills. At the two unusually large mills of the Utah Copper Co. near Garfield the recovery of copper in the concentrates has increased from 65 per cent during the war period to nearly 86 per cent in 1929. Improvements at these plants during 1929 included the installation of additional Symons cone crushers, ball mills, and Dorr bowl classifiers, which greatly increased their capacity.

The International Smelting Co., in addition to its custom milling of sulphide ores, completed a new flotation plant at International designed to treat oxidized lead ores. The plant was placed in operation early in the summer and treated a large quantity of oxidized lead ore, chiefly from the Tintic district. The capacity of the lead-zinc flotation plant of the Combined Metals Reduction Co. at Bauer was increased during the year from 200 to 700 tons a day by the addition of much new equipment, including a Symons cone crusher, 2 new Hardinge ball mills, 2 Akins classifiers, additional Fagergren flotation machines, and a new Fahrenwald Sub A flotation machine. New thickening and flotation equipment was installed at the large mill of the Silver King Coalition Mines Co. near Park City, which resulted in increasing the recovery of zinc. A new 100-ton flotation plant was erected by the Big Indian Copper Co. to treat oxidized copper ore from its mine in San Juan County, south of Thompsons.

In Utah 18 milling plants were running in 1929; 1 of these used jigs and tables with flotation cells, 1 used ordinary table concentration, 1 used jigs and ordinary tables, 2 used jigs only, and 13 used straight flotation. At two properties copper was precipitated from mine water or from ore leached in place, and most of this copper was recovered at the new mine-water precipitation plant of the Utah Copper Co. near Copperton and at the plant of the Ohio Copper Co. at Lark.

A list of the large mills that were active in 1929 follows:

Large mills in Utah active in 1929

Name of company	Location of mill	Method of treatment	Rated capacity of mill	Class of ore treated	Concentrates produced
			Short tons per day		
Utah Copper Co.	Magna	Flotation	30,000	Copper	Copper.
Do	Arthur	do	30,000	do	Do.
International Smelting Co.:					
Custom sulphide plant.	International	do	1,200	Copper, lead, and lead-zinc-iron.	Copper, lead, zinc, and iron.
Custom oxide plant	do	do	150	Oxidized lead	Oxidized lead.
United States Smelting, Refining & Mining Co. (custom mill).	Midvale	do	1,000	Lead-zinc-iron	Lead, zinc, and iron.
Combined Metals & Reduction Co. (custom mill).	Bauer	do	700	Lead-zinc	Lead and zinc.
Silver King Coalition Mines Co.	Park City	do	800	do	Do.
Chief Consolidated Mining Co.	Eureka	do	200	Oxidized lead	Oxidized lead.
Utah-Apex Mining Co.	Bingham	do	700	Copper-lead and lead-zinc.	Copper-lead, lead, and zinc.
Park Utah Consolidated Mines Co. (Judge mill).	Park City	Gravity and flotation.	500	Lead-zinc	Lead and lead-zinc.

A circular[3] giving the flotation reagents used in 1928 and the kinds of ore treated by flotation, with the results, was issued by the Bureau of Mines in 1930. A report for 1929, giving the flotation reagents used and the kinds and grade of concentrates made by flotation from various kinds of ore, will be issued in similar form.

Concentrates produced in Utah in 1929 yielded 69 per cent of the gold, 59 per cent of the silver, 94 per cent of the copper, 65 per cent of the lead, and nearly all the zinc. The quantity of copper concentrates, which exceeded all others combined, increased 6 per cent, and the grade of the concentrates increased from 31 per cent of copper in 1928 to 32 per cent in 1929. Good increases were also made in the production of lead concentrates, dry and siliceous concentrates, and zinc concentrates. The decided increase in the production of lead concentrates was due to the production of oxidized lead concentrates at International. Included with the dry and siliceous concentrates was a large quantity of iron concentrates, containing gold and silver with a little copper and lead, made at custom flotation plants treating galena-sphalerite-pyrite ores.

In 1929, 18 concentrating plants in Utah treated 19,211,775 tons of mill ore and old tailings from Utah mines. Crude mill ore amounted to 18,961,775 tons and old tailings to 250,000 tons. Of this total, 19,078,281 tons (99.31 per cent) was treated by flotation, 123,668 tons (0.64 per cent) by combined gravity and flotation, and the remaining 9,826 tons (0.05 per cent) by gravity machines without flotation equipment. The following table gives a summary of all ores and old tailings treated and a separation by classes of ore. The concentrates produced have been separated by classes and by the three methods of concentration.

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[3] Miller, T. H., and Kidd, R. L., Flotation Reagents, 1928: Rept. of Investigations, Serial 3004, Bureau of Mines, 1930, 19 pp.

Utah ore and old tailings concentrated in 1929, by classes of ore, etc., methods of concentration, and classes of concentrates

Class of material concentrated	Method of concentration	Ore and old tailings concentrated	Gross content of mill feed				
			Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore:							
Copper sulphide	Flotation	17, 765, 569	161, 889. 45	1, 571, 430	354. 146, 417		
Copper-lead sulphide	do	43, 870	2, 237. 37	100, 024	1, 351, 196	2, 544, 460	
Lead oxidized	do	98, 568	9, 521. 56	1, 320, 713	300, 778	33, 077, 082	
Lead sulphide	do	30, 340	3, 136. 70	62, 072	203, 057	4, 827, 632	
Lead-zinc sulphide	do	889, 934	51, 443. 77	7, 928, 601	6, 438, 488	153, 274, 622	123, 904, 701
		18, 828, 281	228, 228. 85	10, 982, 840	362, 439, 936	193, 723, 796	123, 904, 701
Do	Gravity and flotation	123, 668	2, 402. 00	666, 557	221, 160	24, 806, 087	26, 570, 995
Copper sulphide and lead sulphide	Gravity	9, 826	1, 475. 70	31, 336	90, 003	1, 375, 400	
Total ore		18, 961, 775	232, 106. 55	11, 680, 733	362, 751, 099	219, 905, 283	150, 475, 696
Old tailings:							
Lead-zinc sulphide	Flotation	250, 000	56. 60	18, 600	30, 900	215, 700	1, 070, 000
Grand total		19, 211, 775	232, 163. 15	11, 699, 333	362, 781, 999	220, 120, 983	151, 545, 696

Utah ore and old tailings concentrated in 1929, by classes of ore, etc., methods of concentration, and classes of concentrates—Continued

Class of material concentrated	Method of concentration	Concentrates produced		Gross content of concentrates				
		Class	Quantity	Gold	Silver	Copper	Lead	Zinc
			Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore:								
Copper sulphide	Flotation	Copper sulphide	474, 317	116, 963. 19	1, 192, 197	303, 411, 151		
Copper-lead sulphide	do	Copper-lead sulphide	4, 887	1, 175. 15	67, 830	1, 079, 143	1, 953, 727	
Lead oxidized	do	Lead oxidized	39, 698	6, 997. 34	1, 192, 034	194, 820	30, 559, 560	
Lead sulphide	do	Lead sulphide	4, 746	1, 883. 60	60, 936	104, 256	4, 252, 009	
Lead-zinc sulphide	do	do	129, 242	24, 867. 26	6, 594, 430	4, 585, 990	137, 827, 042	
		Iron sulphide	62, 628	7, 302. 27	202, 499	406, 105	2, 087, 623	
		Zinc sulphide	[1] 89, 827	4, 040. 48	545, 075	1, 004, 961	4, 947, 367	96, 145, 619
			805, 345	163, 229. 29	9, 855, 001	310, 786, 426	181, 627, 328	96, 145, 619
Do	Gravity and flotation	Lead sulphide	26, 826	1, 711. 96	539, 385	155, 646	21, 256, 192	
		Iron sulphide	2, 000	96. 73	7, 136	15, 000	45, 000	
		Zinc sulphide	15, 015	193. 57	15, 020	20, 383	72, 392	16, 583, 479
Copper sulphide and lead sulphide	Gravity	Lead sulphide	1, 981	81. 75	17, 861	10, 792	952, 627	
		Copper sulphide	877	1, 088. 00	5, 309	59, 923	13, 680	
Total from ore			852, 044	166, 401. 30	10, 439, 712	311, 048, 170	203, 967, 219	112, 729, 098
Old tailings:								
Lead-zinc sulphide	Flotation	Lead sulphide	170	35. 07	13, 182	11, 995	179, 000	
		Zinc sulphide	838	2. 93	1, 153	3, 209	11, 147	873, 000
Total from old tailings			1, 008	38. 00	14, 335	15, 204	190, 147	873, 000
Grand total			853, 052	166, 439. 30	10, 454, 047	311, 063, 374	204, 157, 366	113, 602, 098

[1] Includes 291 tons of lead-zinc concentrates.

In 1929 exact figures on the contents of the mill ore in Utah were again obtained; they are presented in the accompanying tables. The original feed to the concentration mills—19,211,775 tons of ore and old tailings of all classes—contained 232,163.15 ounces of gold, 11,699,333 ounces of silver, 362,781,999 pounds of copper, 220,120,983 pounds of lead, and 151,545,696 pounds of zinc. The ore and old tailings were reduced to 853,052 tons of concentrates of all classes, an average ratio of concentration of 22.52:1. The concentrates contained 166,439.30 ounces of gold, 10,454,047 ounces of silver, 311,063,374 pounds of copper, 204,157,366 pounds of lead, and 113,602,098 pounds of zinc. The calculated recoveries are as follows: Gold, 71.69 per cent; silver, 89.36 per cent; copper, 85.74 per cent; lead, 92.75 per cent; and zinc, 74.96 per cent. The calculated recoveries for 1928 were as follows: Gold, 69.92 per cent; silver, 82.93 per cent; copper, 85.22 per cent; lead, 88.17 per cent; and zinc, 67.87 per cent. A comparison of these figures indicates an improved recovery of all five metals, particularly silver, lead, and zinc. The following table gives the metallurgic results obtained in 1929 in the treatment of Utah ores by flotation:

Metallurgic results obtained by flotation of Utah ores in 1929

Class of ore treated	Concentrates produced	Ratio of concentration	Per cent recovered in concentrates				
			Gold	Silver	Copper	Lead	Zinc
Copper sulphide	Copper sulphide	37. 46:1	72. 25	75. 87	85. 67	--------	--------
Copper-lead sulphide	Copper-lead sulphide	8. 98:1	52. 52	67. 81	79. 87	76. 78	--------
Lead oxidized	Lead oxidized	2. 48:1	73. 49	90. 26	64. 77	92. 39	--------
Lead sulphide	Lead sulphide	6. 39:1	60. 05	98. 17	51. 34	88. 08	--------
Lead-zinc sulphide	do	6. 89:1	48. 34	83. 17	71. 23	89. 92	--------
	Iron sulphide	14. 21:1	14. 19	2. 55	6. 31	1. 36	--------
	Zinc sulphide	9. 91:1	7. 85	6. 87	15. 61	3. 23	77. 60
Total lead-zinc sulphide		3. 16:1	70. 38	92. 59	93. 15	94. 51	77. 60
Total ore by flotation		23. 38:1	71. 52	89. 73	85. 75	93. 76	77. 60

Gross metal content of Utah concentrates produced in 1929, by classes of concentrates

Class of concentrates	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	64, 628	7, 399. 00	209, 635	421, 105	2, 132, 623	------------
Copper	475, 194	118, 051. 19	1, 197, 506	303, 471, 074	13, 680	------------
Lead	202, 663	35, 576. 98	8, 417, 828	5, 063, 499	195, 026, 430	------------
Zinc	105, 389	4, 209. 83	557, 989	1, 021, 993	4, 983, 204	113, 299, 803
Copper-lead	4, 887	1, 175. 15	67, 830	1, 079, 143	1, 953, 727	------------
Lead-zinc	291	27. 15	3, 259	6, 560	47, 702	302, 295
	853, 052	166, 439. 30	10, 454, 047	311, 063, 374	204, 157, 366	113, 602, 098
Total, 1928	793, 009	155, 506. 66	9, 045, 020	288, 211, 264	176, 759, 101	106, 836, 658

Mine production of metals from Utah concentrates in 1929, in terms of recovered metals

BY COUNTIES

	Ore and old tailings to concentrating mills		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	6,006	--------	2,343	47.42	34,989	17,831	1,021,369	1,277,341
Juab	27,916	--------	7,999	809.65	353,512	50,265	4,615,082	492,803
Salt Lake	18,312,801	--------	645,280	137,741.48	3,277,244	296,926,096	75,931,116	43,675,758
San Juan	300	--------	60	1.01	44	34,313	--------	--------
Summit	195,850	250,000	54,334	3,741.37	3,193,005	1,537,603	43,621,322	16,460,364
Tooele	16,663	--------	4,351	193.19	40,860	27,993	2,211,678	1,048,727
Utah	82,092	--------	35,442	7,430.57	888,449	161,288	25,630,940	558,242
Wasatch	320,147	--------	103,243	16,474.61	2,665,944	903,953	40,646,720	39,469,348
	18,961,775	250,000	853,052	166,439.30	10,454,047	299,659,342	193,678,227	102,982,583
Total, 1928	17,676,445	185,237	793,009	155,506.66	9,045,020	277,651,410	167,564,745	93,857,352

BY CLASSES OF CONCENTRATES

Dry and siliceous	64,628	7,399.00	209,635	286,325	2,010,402	--------
Copper	475,194	118,051.19	1,197,506	293,605,026	13,000	--------
Lead	202,663	35,576.98	8,417,828	3,933,850	185,238,924	--------
Zinc	105,389	4,209.83	557,989	964,608	4,511,642	102,715,959
Copper-lead	4,887	1,175.15	67,830	863,314	1,861,041	--------
Lead-zinc	291	27.15	3,259	6,219	43,218	266,624

Ore of all kinds shipped to the smelters amounted to 3 per cent of the total output and yielded 29 per cent of the gold, 39 per cent of the silver, 4 per cent of the copper, 35 per cent of the lead, and a small quantity of zinc. An unusually large decrease was recorded in the shipments of first-class lead ore, but there was a decided increase in the shipments of copper ore and siliceous ore.

Gross metal content of Utah crude ore shipped to smelters in 1929, by classes of ore

Class of ore	Ore (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	193,954	32,987.33	2,456,271	2,228,686	9,619,090	--------
Copper	126,863	19,301.85	411,064	7,957,107	1,720,426	--------
Lead	237,707	18,446.77	4,005,373	1,980,900	102,693,274	--------
Zinc	43	--------	--------	--------	860	28,221
Copper-lead	265	9.23	7,027	19,362	61,540	--------
Lead-zinc	35	--------	--------	--------	4,155	13,240
	558,867	70,745.18	6,879,735	12,186,055	114,099,345	41,461
Total, 1928	511,606	53,034.78	7,768,566	9,807,994	134,234,090	--------

Mine production of metals from Utah crude ore shipped to smelters in 1929, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	4,056	187.88	37,071	58,646	1,096,806	11,250
Box Elder	144	----------	88	20,205	8,238	----------
Juab	146,253	10,996.99	1,962,637	2,112,084	12,721,664	----------
Millard	5	.05	13	----------	3,349	----------
Piute	2,123	864.41	5,253	3,473	8,667	----------
Salt Lake	204,095	23,281.14	1,397,318	8,209,725	23,300,737	----------
San Juan	62	----------	31	17,460	----------	----------
Sevier	43	----------	----------	----------	683	25,652
Summit	5,320	173.25	170,929	39,328	383,345	----------
Tooele	45,967	6,348.17	346,581	301,757	21,387,560	----------
Uintah	10	----------	28	5,898	----------	----------
Utah	145,285	28,599.29	2,839,655	574,279	44,267,552	----------
Wasatch	5,364	294.00	120,131	30,570	406,581	----------
Washington	140	----------	----------	81,477	----------	----------
	558,867	70,745.18	6,879,735	11,454,902	103,585,182	36,902
Total, 1928	511,606	53,034.78	7,768,566	8,967,039	123,232,488	----------

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous	193,954	32,987.33	2,456,271	2,155,930	5,085,788	----------
Copper	126,863	19,301.85	411,064	7,713,682	878,998	----------
Lead	237,707	18,446.77	4,005,373	1,569,612	97,557,925	----------
Zinc	43	----------	----------	----------	683	25,652
Copper-lead	265	9.23	7,027	15,678	58,463	----------
Lead-zinc	35	----------	----------	----------	3,325	11,250

The miscellaneous material consisted of 61,331 tons of old tailings, slag, and matte shipped for smelting and copper from mine-water precipitates and from leaching of ore in place. This miscellaneous material yielded 3,149.47 ounces of gold, 258,584 ounces of silver, 7,168,279 pounds of copper, and 1,491,020 pounds of lead, valued in all at $1,558,482; most of the gold, silver, and lead in this material came from old tailings from the Tintic district in Juab and Utah Counties, whereas most of the copper was recovered from precipitates from ore leached and from mine waters from the Bingham or West Mountain district, in Salt Lake County.

REVIEW BY COUNTIES AND DISTRICTS

BEAVER COUNTY

In 1929, ten lode mines in Beaver County produced 10,062 tons of ore, yielding metals valued at $275,224, a decided increase from $75,237 in 1928. The increase in the shipments of lead-zinc ore from the Horn Silver mine near Frisco and silver-lead ore from the Moscow property in the Star district accounted for the increased output.

Beaver Lake district.—The property of the Beaver Copper Co. was worked nine months of the year, and one car of first-class oxidized copper ore was shipped to the smelter at Garfield. Development in 1929 consisted of 150 feet of work in the copper section of the property and 200 feet of sinking and drifting in the lead-silver section. Low-grade silver-lead ore was said to have been opened on the 230-foot level.

Newton district.—The old Sheep Rock mine was worked by a lessee, who shipped a small test lot of gold and silver ore. Considerable work was done in 1929 in cleaning out old stopes and drifts and retimbering the 300-foot shaft.

Rocky district.—The Montreal mine, 5 miles northwest of Milford, was worked by a lessee, and two cars of oxidized copper ore were shipped to the smelting plant at Garfield. The property is owned by the Milford Copper Co. and has been a large producer of iron ore for use as flux.

San Francisco district.—An interesting feature of the year was the large output of ore from the old Horn Silver mine. The property was worked continuously and considerable money was spent in rehabilitating the old shaft and various levels and in buying new equipment. The Tintic Lead Co. secured the property late in 1928, and more than 4,000 feet of development was done in 1929, chiefly in drifting. The mine is opened by a 1,600-foot vertical shaft and by several miles of drifts and other workings. The output in 1929 consisted chiefly of lead-zinc ore milled in the custom flotation plant of the Combined Metals Reduction Co. at Bauer, and more than 1,000 tons of first-class silver-lead ore was shipped for smelting. The chief commercial minerals contained in the ore are galena, sphalerite, pyrite, chalcopyrite, and anglesite. According to a report made to the industrial commission the mine produced 8,689 wet tons of ore, containing 230 ounces of gold, 67,475 ounces of silver, 36,167 pounds of copper, 1,722,425 pounds of lead, and 2,083,609 pounds of zinc. The property ranked tenth in the production of zinc in Utah in 1929 and was also a large producer of silver and lead. The following paragraphs are taken from the printed annual report of the Tintic Lead Co.:

> To rehabilitate the surface equipment, to retimber the shaft and levels of the Horn Silver mine took until May, 1929, and cost nearly $150,000.
>
> The sixteen hundred-foot triple compartment shaft was retimbered to the eleven hundred-foot level. * * *
>
> The mine has been equipped with a new compressor, new change rooms, and splendid machine shop equipment. * * *
>
> The Union Pacific spent during the year $40,000 for improvements in their railroad branch extending to our properties, including the three spur lines on our properties.
>
> Since May, 1929, more than $167,000 has been expended for labor and development. * * *
>
> Within two hundred feet of the old ore body was disclosed the one we are now following. This has been proven for four hundred feet in length, fifty feet in thickness, and seventy-five feet in width, and has been opened at five different points on the 900 level. * * *
>
> In accomplishing these things we have done more than a mile of development work and shipped ore for which we received nearly $100,000. A foot of development work has been done for each four tons shipped and we have blocked out definitely 100,000 tons of ore. * * *
>
> The new ore body disclosed on the 900 level contains gold, silver, lead, zinc, and a small amount of copper. Ore is being mined from the surface to and including the 1,000 level.
>
> Above the 300 level a splendid gold stope was opened from which we expect a very substantial tonnage during the first half of 1930.
>
> On the 44 level we have a splendid showing of high-grade lead and during the first six months of 1930 we trust that the fissure will lead us to such a stope as made the Horn Silver famous in the early years of its operations.

The Manhattan Copper & Gold Co. worked the Imperial property under lease and shipped several cars of low-grade oxidized copper ore from the dump. The property is at the head of Loeber Gulch, 2 miles northwest of the Horn Silver mine.

Star and North Star district.—Five lode mines in the Star district produced 1,868 tons of ore, which yielded $894 in gold, 18,049 ounces of silver, 23,980 pounds of copper, and 735,794 pounds of lead, valued in all at $61,090, or $32.70 in metals a ton. All the ore was first-class smelting material, which consisted chiefly of oxidized silver-lead ore from the Moscow property. This mine was operated the entire year by the Moscow Silver Mines Co., which shipped more than 1,700 tons of mixed ore. According to the annual report of the company the net income for the fiscal year March 1, 1929, to February 28, 1930, was $35,055. Development in 1929 consisted of 1,921 feet of drifting, 195 feet of raising, 143 feet of winze sinking, and 186 feet of shaft sinking. The property is opened by a vertical shaft 1,400 feet deep and by 23,692 feet of drifts.

Other producers in the district were the Capitol Hill, Beaver Crown, Magnolia, and Yellow Pine properties.

BOX ELDER COUNTY

Lucin district.—The Copper Mountain mine, owned by the Salt Lake Copper Co., was operated by lessees who shipped three cars of oxidized copper ore of smelting grade. The property is close to the State line between Utah and Nevada, and the ore is hauled to Tuttle, Nev., a station on the Southern Pacific Railroad.

Newfoundland district.—A small quantity of first-class oxidized copper ore was marketed from the property of the Rocky Mountain Copper Co.

Sierra Madre district.—The Alvarado property, 12 miles north of Ogden, was worked part of the year, and a car of oxidized lead ore was shipped to the smelter at Murray.

GRAND COUNTY

La Sal district.—A small quantity of placer gold was produced from the Big Six placer by the Utah Placer Gold Mines (Inc.). Considerable work was done in 1929 in installing new machinery, erecting buildings, and constructing a dam to provide water. The company's holdings include 3,500 acres of placer ground near the Henry Mountains, in Garfield County, in addition to the Big Six property in Grand County.

JUAB COUNTY

Twenty-four lode mines in Juab County produced metals valued at $3,219,476 in 1929, an increase from $3,036,754 in 1928, but a marked decrease compared with $5,658,891, the value of the output in 1927. Most of the ore and old tailings came from mines and dumps near Eureka, mentioned in the review of the Tintic district. The production of metals from the Chief Consolidated, Mammoth, Bullion Beck & Champion, Centennial Eureka, and Victoria properties increased considerably, but large decreases were recorded from the Plutus and Eagle & Blue Bell mines and from the Mammoth dump of old tailings.

Fish Springs district.—A small lot of sulphide lead ore was shipped from the Utah mine near Callao by a lessee, and considerable development was done at the property late in the year.

Gilson Mountain district.—A small test lot of sulphide lead ore was shipped from the Arrowhead mine, which is 4 miles north of Leamington and is owned by the Arrowhead Metal Mining Co. The company began to develop the property in January after installing a compressor and other surface equipment.

Tintic district.—The production from the old mines near Eureka in the western part of the Tintic district in Juab County has decreased gradually in recent years, although the production in 1929 exceeded that of 1928. In the eastern section of the Tintic district in Utah County the output from the comparatively new mines has increased decidedly. The mines in both sections of the Tintic district are reviewed here, and their output is included in the following table.

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Utah, 1928 and 1929, and total, 1869–1929, in terms of recovered metals

	Mines producing	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc	Total value
1929		*Short tons*		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Juab County	21	207,967	$291,049	2,495,229	2,445,989	18,002,239	492,803	$3,218,166
Utah County	13	247,349	726,244	3,777,227	720,170	70,224,460	558,242	7,327,241
	34	[1] 455,316	1,017,293	6,272,456	3,166,159	88,226,699	1,051,045	10,545,407
Total, 1928	27	[2] 379,349	711,252	6,232,602	2,456,896	88,192,591	41,563	9,828,823
Total, 1869–1929		(3)	40,330,432	217,362,265	213,549,777	1,543,676,739	30,035,373	325,131,293

[1] Includes 59,423 tons of old tailings and 108 tons of old slag sold to a smelter.
[2] Includes 46,142 tons of old tailings sold to a smelter.
[3] Figures not available.

NOTE.—Total dividends, 1869–1929, $52,491,331.

The value of the metals from the Tintic district in 1929 was as follows: Gold, $1,017,293, compared with $711,252 in 1928; silver, $3,343,219, compared with $3,646,072; copper, $557,244, compared with $353,793; lead, $5,558,282, compared with $5,115,171; and zinc, $69,369, compared with $2,535. The ore and old tailings sold or treated in the district in 1929 yielded on an average $23.16 in metals a ton, compared with $25.91 in 1928.

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Utah, in 1929, by classes of ore, in terms of recovered metals

Class of ore	Mines producing	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	29	[1] 228,831	33,463.56	2,313,273	2,227,932	5,622,481	
Copper	5	7,086	482.61	114,581	426,453	243,000	
Lead	17	212,905	15,110.14	3,807,996	505,644	81,388,661	
Lead-zinc	3	6,494	155.23	36,606	6,130	972,557	1,051,045
	[2] 34	455,316	49,211.54	6,272,456	3,166,159	88,226,699	1,051,045

[1] Includes 59,423 tons of old tailings and 108 tons of old slag sold to a smelter.
[2] A mine producing more than one class of ore is counted but once in arriving at total for all classes.

There was a large increase in the metals produced by the Chief Consolidated properties—the Chief No. 1, Grand Central, Eureka Hill, and Tintic Bullion mines. The Chief Consolidated flotation plant at Eureka was operated intermittently; the volatilization plant, formerly used on low-grade ore from the Eureka Lilly mine in the eastern part of the district and on low-grade tailings from the Eureka Hill dump, was idle. The total shipments of ore of the Chief Consolidated Mining Co., including 26,156 tons of mill ore, were reported as 74,383 tons in 1929, compared with 58,734 tons in 1928. This total includes ore from the property of the Plutus Mining Co., a separate incorporation controlled and worked by the Chief Consolidated Mining Co., but excludes ore produced from the Eureka Lilly and Eureka Bullion mines. After transportation, sampling, and all operating charges were deducted, the ore yielded a profit of $56,565. No dividends were paid in 1929, but a total of $3,654,519 has been paid since the first dividend of Feburary, 1913.

The combined metal contents of the ores from the Chief Consolidated properties, including the output of the Plutus mine, are given as follows in the company's annual report. The totals do not represent recovered metals but are assay contents of ores milled and ores shipped for smelting. The methods used at the flotation plant at Eureka are fully described in a circular[4] published in July, 1930

Metal contents (assay) of crude smelting ore and mill ore from Chief Consolidated property and Plutus mine, 1928 and 1929

Year	Ore	Gold	Silver	Copper	Lead	Zinc	Net returns	
							From smelter	After charges
	Dry tons	*Ounces*	*Ounces*	*Pounds*	*Pounds*	*Pounds*		
1928	58,734	3,846	1,244,844	472,958	12,163,714	9,822	$1,336,058	$162,223
1929	66,864	4,172	1,170,197	475,723	8,547,592	946,452	709,436	----------

The output of the Chief or No. 1 mine is given for 1929 separately—19,774 tons of ore, 1,004 ounces of gold, 288,937 ounces of silver, 20,434 pounds of copper, 3,831,742 pounds of lead, and 700,009 pounds of zinc. The company received $221,732 from the sale of the ore, and after various charges were deducted the net profit was $39,338. Of the 19,774 tons of ore, 3,490 tons of silver-lead ore and 5,021 tons of dry and siliceous ore were shipped for smelting; the custom flotation plant at Midvale received 3,508 tons of lead-zinc ore; and the concentrator at the Chief mine received 7,755 tons, of which 6,942 tons represented silver-lead ore and 813 tons dry and siliceous ore. These ores averaged as follows: Gold, $1.05; silver, 14.612 ounces; lead in lead ores, 16.24 per cent; copper in copper ores, 0.41 per cent; lead in zinc-lead ores, 6.31 per cent; and zinc in zinc-lead ores, 9.98 per cent. All ores averaged $26.08 a ton in total value, and after $15.58 was deducted for smelting, freight, and sampling the net value was $10.50 a ton. More than 1,600 feet of development was done in the Chief No. 1 mine in 1929, chiefly in drifting and raising.

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[4] Wigton, G. H., Milling Methods and Costs at the Concentrator of the Chief Consolidated Mining Co., Eureka, Utah: Inf. Circ. 6320, Bureau of Mines, July, 1930, 18 pp.

The output of the Chief mine from 1909, the year of discovery, to 1929 was as follows: 1,220,255 tons of ore, 80,615 ounces of gold, 31,830,135 ounces of silver, 464,892 pounds of copper, 204,876,743 pounds of lead, 22,048,401 pounds of zinc, and 1,117,971 pounds of manganese, for which the smelters paid $24,782,205; after various charges were deducted the net profit was $5,886,554. The Grand Central or No. 5 mine in 1929 produced 20,415 tons of ore, 2,208 ounces of gold, 224,438 ounces of silver, 360,710 pounds of copper, and 1,404,062 pounds of lead. The ore sold for $156,649, and after various charges were deducted the net profit was $14,617. Of the 20,415 tons of ore, 14,495 tons of dry and siliceous ore and 2,223 tons of silver-lead ore were shipped for smelting, and the concentrator at the Chief mine received 3,697 tons, of which 3,244 tons represented silver-lead ore and 453 tons dry and siliceous ore. These ores averaged as follows: Gold, $2.23; silver, 10.99 ounces; copper in copper ores, 1.20 per cent; and lead in lead ores, 12.84 per cent. All ores averaged $17.10 a ton in total value, and after $9.43 was deducted for smelting, freight, and sampling the net value was $7.67 a ton. About 2,080 feet of development was done in the Grand Central mine in 1929, chiefly in drifting. Since the property was acquired by the Chief Consolidated company in 1922 the Grand Central has produced 210,851 tons of ore, 54,067 ounces of gold, 3,033,625 ounces of silver, 6,379,298 pounds of copper, and 8,911,332 pounds of lead, for which the smelters paid $2,675,848; after various charges were deducted the net profit was $294,739. The report of the Chief Consolidated Mining Co. says:

> The Grand Central mine before its purchase by your company had paid one million nine hundred thousand dollars in dividends and since its acquisition by your company has produced over 210,000 tons of ore with a profit of better than $294,000 and gives promise of being steadily profitable under ordinary favorable metal price conditions.

The Plutus mine, controlled and operated by the Chief Consolidated Mining Co., produced 25,740 tons of oxidized silver-lead ore containing 887 ounces of gold, 647,936 ounces of silver, 92,834 pounds of copper, and 3,108,328 pounds of lead. The output decreased considerably from the 1928 record of 32,936 tons containing 1,301 ounces of gold, 805,585 ounces of silver, 196,341 pounds of copper, and 8,221,511 pounds of lead. Of the 25,740 tons of ore, 10,392 tons of dry and siliceous ore and 5,638 tons of silver-lead ore were shipped for smelting, and the concentrator at the Chief mine received 9,710 tons, of which 6,391 tons represented silver-lead ore and 3,319 tons dry and siliceous ore. These ores averaged as follows: Gold, $0.70; silver, 25.173 ounces; lead in lead ores, 12.92 per cent; and copper in copper ores, 0.70 per cent. All ores averaged $25.16 a ton in total value, and after $12.83 was deducted for smelting, freight, and sampling the net value was $12.33 a ton. About 10,385 feet of development was done in the Plutus mine in 1929, chiefly in drifts, raises, and winzes. The Chief Consolidated Mining Co. received $317,554 from the sale of ore, and after various expenses were deducted the net loss was $58,475. Since the controlling interest in the Plutus mine was acquired by the Chief Consolidated Mining Co. in 1923 the property has produced 151,012 tons of ore, 5,906 ounces of gold, 4,241,038 ounces of silver, 1,135,541 pounds of copper, and 37,192,805 pounds of lead, for which the smelters paid $3,245,157; after various charges were deducted the net profit was $1,040,192. The following paragraph is taken from the report of the Chief Consolidated Mining Co.:

> The Plutus mine, owned by the company of that name, nearly 92 per cent of whose shares are owned by your company, existed about eight years after its organization without doing any substantial work of exploration and it was not until its purchase by your company that any real work of that character was commenced. The first discovery of ore was made by your management through its Grand Central workings in 1922 and since that time it has mined and shipped over 150,000 tons of ore with a profit of over a million dollars. There has since been some difficulty in continuing the production at the same rate and profit because of faulting and the evident tendency of the ore run to make to greater depth. To meet this difficulty a connecting crosscut was run over on to the property for a half mile from the Chief No. 1 shaft at a greater depth than the workings of the Grand Central and a mile of openings made from that end, with the result that new ore runs have been picked up and the production to a considerable extent revived and the earnings approaching restoration. * * *

The Chief Consolidated Mining Co. received $1,152,992 from the sale of ore, concentrates, lime, etc., and the costs were $1,096,427, leaving a net operating profit of $56,565. Other income amounting to $181,847, chiefly from the profits derived from the purchase and sale of miscellaneous investments, brought the total income to $238,412. Miscellaneous expenses, including Federal and State taxes, amounted to $87,753, leaving a net profit for the year of $150,659. The net surplus on December 31, 1929, was $3,483,056. The net profit from mining operations at the Chief Consolidated property was $84,221; the net loss from operations at the Plutus mine was $58,475; and the net loss from operations at the Eureka Lilly mine was $18,208, making a net operating profit to the Chief Consolidated Mining Co. of $20,008.

The control of the Eagle & Blue Bell Mining Co. was purchased in July from the Bingham Mines Co. by the United States Smelting, Refining & Mining Co. The property was worked by the Bingham Mines Co. until July 22, when it was turned over to the new owner. The mine was worked continuously and produced more than 4,000 tons of siliceous silver ore and oxidized lead ore. The output, however, represented a marked decrease from 20,324 tons produced in 1928.

The Victoria property of the Bingham Mines Co., adjoining the Eagle & Blue Bell mine, southeast of Eureka, was also purchased in July by the United States Smelting, Refining & Mining Co. The mine was worked continuously, and according to a report to the industrial commission shipped to the smelters 18,288 tons of first-class ore, which contained 1,094 ounces of gold, 322,910 ounces of silver, 382,275 pounds of copper, and 3,677,816 pounds of lead, valued in all at $439,335. After various charges, including cost of extraction and freight and smelter charges, were deducted the net profit was $76,987. About half the output, which increased considerably over that in 1928, was oxidized silver-lead ore, and the remainder was chiefly oxidized copper ore. More than 4,500 feet of development, chiefly in drifting. was done in 1929.

The Mammoth Mining Co. continued to operate its property near Mammoth south of Eureka and shipped nearly 29,000 tons of siliceous silver ore and oxidized silver-lead ore of smelting grade. More than 82 per cent of the output was siliceous silver ore containing gold and copper. The report to the industrial commission gave 28,990 tons of ore containing 1,773 ounces of gold, 493,913 ounces of silver.

353,943 pounds of copper, and 1,251,735 pounds of lead; the net proceeds were only $29,939. The production was an increase over that in 1928, when shipments aggregated 14,685 tons of ore containing 738 ounces of gold, 295,335 ounces of silver, 415,072 pounds of copper, and 649,544 pounds of lead. No dividends were paid in 1929, but a total of $3,136,251 has been paid to date.

The Empire Mines Co. did no work in its mine in 1929 but shipped 2,635 tons of siliceous gold and silver ore from old waste dumps. The material contained 373.68 ounces of gold, 17,368 ounces of silver, 33,774 pounds of copper, and 123,003 pounds of lead.

The Bullion Beck & Champion property, controlled by the United States Smelting, Refining & Mining Co., was active in 1929 and according to a report to the industrial commission shipped 19,346 tons of ore and old tailings for smelting. The material contained 438 ounces of gold, 118,886 ounces of silver, 96,671 pounds of copper, and 1,721,468 pounds of lead, and the resulting production was a decided increase over that of 1928, when 3,570 tons of ore and old tailings were shipped. Most of the output in 1929 (62 per cent) was low-grade ore from stope fills containing chiefly silver and lead; the remainder was principally old silver-lead tailings.

The Iron Blossom mine near Silver City, owned by the Tintic Standard Mining Co., produced about 4,000 tons of mixed ore, chiefly oxidized silver-lead ore. The production is included in the statement of the Tintic Standard Mining Co. (See p. 609.)

The Centennial Eureka property was operated by the United States Smelting, Refining & Mining Co. According to a report to the industrial commission 21,122 tons of ore was shipped, containing 2,772 ounces of gold, 88,625 ounces of silver, 316,116 pounds of copper, and 79,669 pounds of lead. Nearly all the material was low-grade siliceous ore from waste dumps; the production was distinctly increased over that in 1928.

No regular development was done at the Gold Chain mine in 1929, but nearly 700 tons of oxidized copper ore was shipped by lessees.

The Dragon Consolidated Mining Co. did no development in its property in 1929 but lessees shipped 642 tons of low-grade siliceous ore from the dump; the material contained 35 ounces of gold, 4,004 ounces of silver, and 19,669 pounds of copper.

The American Smelting & Refining Co. continued to ship old tailings from the Mammoth dump, but the quantity smelted in 1929 was only half that in 1928. The material contains gold, silver, copper, and lead, but is chiefly valuable for its gold and silver; it is used as siliceous flux at the copper smelter at Garfield.

Shipments of old tailings were also continued from the Eureka Hill dump at Eureka, owned and operated by the Chief Consolidated Mining Co. In 1929 all this material was shipped for smelting.

Other producers in the Juab County part of the Tintic district in 1929 were the Alaska, Early Bird, Laclede, Little May, Showers, Swansea, Undine, and United Sunbeam properties. Several cars of ore containing chiefly silver were cleaned up from around the old site of the Tintic Milling Co. and shipped for smelting.

The chief producers in the eastern part of the Tintic district in Utah County were the Tintic Standard, North Lily, Eureka Standard, Eureka Lilly, Mountain View, Yankee Consolidated, Utah Consolidated, and Tintic Bullion properties. An interesting feature in this section was the marked improvement in the output of the North Lily mine, which increased from 49,962 tons in 1928 to 72,889 tons in 1929. Most of the output in 1929 (97 per cent) was oxidized silver-lead ore from the upper levels of the mine shipped to the lead smelter and to the new oxide flotation plant at International; the remaining 3 per cent was sulphide lead-zinc ore from the deeper levels of the mine, shipped to the International sulphide concentration plant. The ore is delivered from the shaft to the railway siding by an aerial tramway nearly 4,000 feet long. Development work aggregating 13,735 feet was done chiefly in drifts and crosscuts, and the 4-compartment shaft was sunk an additional 303 feet to the 1,679-foot level. The chief ore mineral is anglesite, but in 1929 much sulphide lead-zinc ore was being mined. According to the printed annual report of the North Lily Mining Co. for the year ended December 31, 1929, the mine produced 72,889 tons of ore, containing 9,413.94 ounces of gold, 790,144 ounces of silver, 33,168,854 pounds of lead, and 492,796 pounds of zinc, which sold for $1,647,108. After mine operating expenses ($657,049), freight on ore shipments ($107,291), and other miscellaneous expenses were deducted an operating profit of $836,863 remained. Income from other sources amounted to $38,928, which made a total income of $875,791; after $82,877 was deducted for depreciation and reserve for Federal taxes the net income was $792,914. On December 31 the surplus was $1,209,622. The mine ranked fifth in the production of lead in Utah in 1929, sixth in gold, and seventh in silver. Dividends of $795,550 were paid in 1929, making a total of $954,660 since the first dividend was paid in September, 1928. The following paragraphs are taken from the company's annual report:

> During the year the property was operated through its main shaft which was sunk 303 feet deeper to a total of 1,679 feet, bottoming in quartzite, and stations were cut for the 1,200 and 1,350 levels. The adjacent properties of the Chief Consolidated were also operated through this shaft and contributed toward its operating expense.
>
> The North Lily mine produced 77,716 wet tons of ore and an equal amount of waste was broken in development, 50 per cent of which was used for stope filling. Ninety-seven per cent of the ore was oxidized lead-silver ore from the upper levels and 3 per cent was sulphide lead-zinc ore from the deeper levels. No ore has yet been found on the 1,200 and 1,350-foot levels.
>
> A vigorous development campaign was carried on throughout the year on all levels of the mine, with the object in view of developing a ton of new ore for each ton of ore mined. Considerable new ore has been found, but the objective has not been attained, as development to the north and northwest on the 7th level, where two headings were being driven into the favorable areas, were greatly retarded by heavy flows of water and bad ground, and the favorable areas were not reached.

Conditions at the North Lily property are described by the superintendent in a statement [5] published in February.

The Tintic Standard and Iron Blossom mines [6] produced 74,317 dry tons of lead ore, 35,741 dry tons of siliceous ore, and 186 dry tons of silver ore. These ores contained 5,196.53 ounces of gold, 2,789,710 ounces of silver, 38,211,540 pounds of lead, and 698,535 pounds of copper, which sold for $4,265,337, compared with $4,446,616 in 1928. After smelter and freight charges of $1,721,094 were deducted the net smelter returns amounted to $2,544,243. Income from other sources amounted to $404,388, which made a total income for the year of $2,948,631. After mine operating expenses ($1,057,889), general administrative expense ($108,861), churn drilling and exploration work ($111,792), annual depreciation of plant and equipment ($41,975), and State, county, and Federal taxes ($245,267) were deducted there remained a net income carried to surplus account of $1,382,847. On December 31 the total current assets of the company were $3,496,069. Dividends of $1,499,329 were paid in 1929, making a total of $12,556,584 since the initial dividend was paid in June, 1917. The Tintic Standard Mining Co. ranked second in the production of silver in Utah in 1929, third in lead, and ninth in gold. The lead ore from the Tintic Standard mine at Dividend contained on the average 0.042 ounce of gold and 27.90 ounces of silver to the ton, 0.288 per cent of copper, and 23.903 per cent of lead. The siliceous ore contained on the average 0.05 ounce of gold and 19.177 ounces of silver to the ton, 0.37 per cent of copper, and 4.24 per cent of lead. The dry silver ore contained on the average 0.266 ounce of gold and 449.065 ounces of silver to the ton, 2.033 per cent of copper, and 4.075 per cent of lead. The lead ore from the Iron Blossom mine near Silver City contained on the average 0.112 ounce of gold and 15.823 ounces of silver to the ton, 0.242 per cent of copper, and 18.378 per cent of lead. The siliceous ore contained on the average 0.069 ounce of gold and 11.90 ounces of silver to the ton, 0.197 per cent of copper, and 4.625 per cent of lead. The dry silver ore contained on the average 0.01 ounce of gold and 0.64 ounce of silver to the ton, 16.06 per cent of copper, and 0.60 per cent of lead. Development in 1929 consisted of 3,550 feet of drifting, 404 feet of raising, and 93 feet of sinking. The company's report gives no details regarding ore reserves; it gives the output of the Tintic Standard mine to date—the ore shipped or milled with metal content—as follows: 1,328,788 tons of ore, 47,692.787 ounces of gold, 35,037,932 ounces of silver, 10,181,873 pounds of copper, and 361,553,422 pounds of lead. It also gives the output of the Iron Blossom mine to date as follows: 598,711 tons of ore, 95,593.676 ounces of gold, 15,565,042 ounces of silver, 7,388,108 pounds of copper, and 66,954,766 pounds of lead. The report continues:

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[5] Finlay, J. S., Finlay Tells Story of Development of North Lily into Dividend Payer: Eng. and Min. Jour., vol. 127, Feb. 2, 1929, p. 212.

[6] Tintic Standard Mining Co. Ann. Rept. for year ended Dec. 31, 1929.

> During 1929 the company enjoyed a prosperous year, although the output of metals was slightly less than in 1928. The low price of silver prevailing through the year reduced, somewhat, the tonnage of siliceous silver ore mined. The loss in silver value was compensated by the slightly higher price of lead. * * *
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> At the Tintic Standard mine, development work to the extent of 7,248 feet of drifting and 1,108 feet of raising was completed. In addition, during the year a number of churn drill holes have been driven to determine the geological structure of the area lying east of the present location of the mine. This work will be completed early in 1930.

A comprehensive report[7] published in October, 1930, gives interesting notes on the history of the Tintic district, a summary of its geology, and data on the mining methods and costs at the Tintic Standard mine.

An interesting development in the eastern part of the Tintic district in Utah County was the large increase in the output of siliceous gold ore from the Eureka Standard mine, which is south of the Tintic

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[7] Wade, James W., Mining Methods and Costs at the Tintic Standard Mine, Tintic District, Utah: Inf. Circ. 6360, Bureau of Mines, October, 1930, 21 pp.

Standard property and is controlled by the Tintic Standard Mining Co. The output increased from 4,296 tons in 1928 to 18,363 tons in 1929. The ore contained 14,755.425 ounces of gold, 193,098 ounces of silver, 68,360 pounds of copper, and 191,981 pounds of lead; the property ranked fourth as a producer of gold in Utah in 1929. Shipments of ore began in June, 1928, and to the end of 1929 the mine had produced 22,659 tons of ore containing 18,040.18 ounces of gold, 238,538 ounces of silver, 82,149 pounds of copper, and 241,912 pounds of lead. In 1929 development consisted of sinking the vertical shaft an additional 243 feet to the 1,300-foot level, drifting 2,613 feet, and raising 1,107 feet. The surface plant at the property was completely rebuilt during the year, making it one of the most complete in the State. A new 85-foot steel headframe having steel ore bins with conveyor belts to the railroad loading platform was erected. A new hoist, compressor, machine shop, and change house were also installed. The following paragraph is taken from the report of the Tintic Standard Mining Co. for 1929:

> At the Eureka Standard mine, on the 1,100 level, we have continued the development to the southwest where an ore body of higher average grade has been found than that found to the northeast. The main shaft has been sunk to the 1,300 level, a crosscut run out to the vein, and development is proceeding along the strike of the vein. The small prospect hoist has been replaced with a larger one adequate for the ore production and development work planned. A compressor, steel headframe, change house, and railroad loading spur were completed during 1929, and the installation of an ore bin and conveying equipment from the shaft to the loading bin was completed by March 1, 1930. All the development work and equipment has been paid from this property's earnings. * * *

The Eureka Lilly Mining Co., controlled by the Chief Consolidated Mining Co., produced 18,139 dry tons of ore, most of which was oxidized silver-lead ore concentrated and siliceous gold ore smelted. The ore contained 6,990 ounces of gold, 79,788 ounces of silver, and 3,994,997 pounds of lead. The net smelter returns were $195,094; after other income ($4,085) was added the total income for the year was $199,179. After $127,549 was deducted for mine operating expenses, $76,019 for development, and $9,734 for State and local taxes there was a net loss of $14,123; the surplus on December 31, 1929, was, however, $100,183. The output represents a decided decrease from 23,117 tons in 1928 containing 8,821 ounces of gold, 191,859 ounces of silver, and 6,614,955 pounds of lead; the net smelter returns in 1928 were $351,292. About 4,700 feet of development was done in 1929, chiefly in drifting. All work is being done through the shaft of the North Lily Mining Co. The following paragraphs are taken from the annual report of the Eureka Lilly Mining Co.:

> All this development is in the vicinity of the east fissure which has proven so productive in the Tintic Standard mine to the east and the North Lily mine to the west. The ore has made in both the quartzite footwall and the abutting limestone beds. This quartzite lime contact dipping gradually to the south covers nearly half of the northern part of the Eureka Lilly property and its entire width and the ore bodies thus far developed give the assurance of their continuity.
>
> The main product at present is coming from between the 600 and 900 levels, the principal metals being gold and lead.
>
> The loss incurred during the year was due to the large amount of development work, but this has opened up some showings of ore and these are now being followed and show signs of continuing. Plans are being worked out for the development of ore to the south extending to and in connection with the

ore being searched for by the Tintic Standard Company in its operations under the lease given to it by the Eureka Lilly Company.

Development work in the southern end of the property under lease to the Tintic Standard Mining Company has not reached the objectives nor made any ore discoveries to date.

A new producer in 1929 in the eastern part of the Tintic district directly west of the North Lily mine was the Tintic Bullion property, owned by the Chief Consolidated Mining Co. According to the printed annual report of the company the mine produced 935 tons of ore, chiefly sulphide lead-zinc ore shipped to Midvale and to International for milling. The crude smelting ore and milling ore contained 73 ounces of gold, 8,886 ounces of silver, 1,745 pounds of copper, 203,460 pounds of lead, and 246,443 pounds of zinc. The ores averaged $39.29 a ton in total value, and after $24.85 was deducted for smelting, freight, and sampling there remained a net value of $14.44 a ton. More than 4,300 feet of development was done in 1929, chiefly in drifting. The following paragraph is taken from the printed annual report of the Chief Consolidated Mining Co.:

> The Tintic Bullion directly owned property of your company lies directly west of the North Lily mine. The exploration that has been carried on during the past year on this tract has also made an important discovery of a good grade of ore which in this case, as at the Eureka Bullion, is being followed up and from which shipments are being made. This also gives promise of making another mine.

Another new producer in the eastern part of the Tintic district was the Eureka Bullion mine, controlled and operated by the Chief Consolidated Mining Co. The mine produced 466 tons of first-class smelting ore containing 156 ounces of gold, 6,084 ounces of silver, and 20,720 pounds of copper. The ore averaged $21.74 a ton in total value, and after $10.14 was deducted for smelting, freight, and sampling, a net value of $11.60 a ton remained. Development in 1929 consisted of 934 feet of drifting and 40 feet of raising, and 42 feet of work was done in the winzes. The following paragraph was taken from the printed annual report of the Chief Consolidated Mining Co.:

> On the Eureka Bullion property owned by a company of that name but controlled by your company a remarkably rich lead of ore has been developed and is being actively followed. This promises to have the continuation of the North Lily ore zone and gives promise of developing a profitable mine.

The Colorado Consolidated property, controlled and operated by the Tintic Standard Mining Co., produced 347 tons of siliceous silver ore and 31 tons of silver-lead ore. These ores contained 38.55 ounces of gold, 3,405 ounces of silver, 944 pounds of copper, and 54,203 pounds of lead. The output decreased considerably from 10,919 tons in 1928. The following paragraph is taken from the report of the Tintic Standard Mining Co.:

> Development in 1929 was continued on two fissures found on the 1,900 level without conclusive results. Work consisting of 2,150 feet of drifting and 176 feet of raising was done.

No work of importance was done in 1929 at the May Day, Yankee Consolidated, or Utah Consolidated properties. Lessees worked the May Day mine and shipped 2,146 tons of low-grade smelting ore containing 182.39 ounces of gold, 16,416 ounces of silver, 3,788 pounds of copper, and 170,827 pounds of lead; about 1,600 tons of similar ore was shipped from the Yankee Consolidated property. The Utah Consolidated Mining & Milling Co. shipped from the old stopes of the mine 1,300 tons of siliceous ore of smelting grade containing an average of 10.44 ounces of silver to the ton and a little gold, copper, and lead.

Several sample lots of siliceous silver ore were shipped from the Sioux mine, and two cars of old tailings containing chiefly gold and silver were shipped from the dump. More than 25,000 tons of old tailings containing an average of 0.03 ounce of gold and 2.61 ounces of silver to the ton, 2.76 per cent of lead, and a little copper was shipped from the mill tailings dump of the Tintic Standard Mining Co. at Harold near Goshen. This highly siliceous material was sent to the smelter at Garfield for use as flux.

The Iron King mine southwest of Dividend was operated by the Tintic Standard Mining Co., chiefly for development. The only product shipped in 1929 was 3,925 tons of iron ore, used as a flux, for which the company received $12,169. Development consisted of 1,686 feet of drifting, but no commercial nonferrous ore was found, although stringers of silver-copper ore were disclosed on the 1,350 and 1,450 foot levels.

Conditions in the Tintic district are reviewed in a short statement[8] published in October.

MILLARD COUNTY

Cricket Mountain district.—A small test lot of high-grade lead ore was shipped from the Galena property. The ore was hauled several miles to Clear Lake, a station on the Los Angeles & Salt Lake Railroad.

PIUTE COUNTY

The value of the production of metals in Piute County decreased from $88,183 in 1928 to $25,815 in 1929, chiefly because of the large decrease in the output of gold ore from the Deer Trail mine near Marysvale.

Gold Mountain district.—A small lot of siliceous gold ore was shipped from this historic district, and a company was organized to work the old Annie Laurie mine and adjoining property.

Mount Baldy district.—The Deer Trail Mining Co. did no work at its property south of Marysvale in 1929, but lessees shipped more than 2,000 tons of low-grade gold ore from the dump and several cars of first-class ore from the mine.

Ohio district.—Several cars of old tailings containing chiefly gold and silver were shipped from the dump of the Bully Boy mine.

SALT LAKE COUNTY

Salt Lake County, chiefly the Bingham district, has been the most important mining center of Utah since 1905. The value of the metal output of the county in 1929 was $69,858,853, or nearly 73 per cent of the total value of the State output. The advance in the price of copper in 1929 resulted in a marked increase in the value of the output of copper, gold, and silver, although there was a decrease in the output of lead and zinc.

The mines of Bingham have been large producers since the early days of mining. Their output increased decidedly after the Utah

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[8] Martin, Gail, Tintic District Still Going Strong After Sixty Years of Production: Eng. and Min. Jour., vol. 128, Oct. 12, 1929, p. 598.

Copper Co. started steam-shovel mining in 1907, and the value of the county's metal output in 1929 was more than five times that in 1907 and nearly $14,500,000 more than that in 1928.

Big and Little Cottonwood districts.—The production of the mines at Alta, the head of Little Cottonwood Canyon, and of those in Big Cottonwood Canyon has been combined in the following table.

Mine production of gold, silver, copper, lead, and zinc in Big Cottonwood and Little Cottonwood mining districts, Utah, 1928 and 1929, and total, 1867–1929, in terms of recovered metals

Year	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1928	9	1,518	$2,839	30,846	139,489	292,975	---------	$57,963
1929	7	1,814	687	30,212	57,989	346,381	87,213	54,574
Total, 1867–1929	-------	604,878	566,938	16,420,910	15,805,187	231,467,565	771,204	33,303,045

In the Big Cottonwood district five lode mines produced 907 tons of ore which yielded $127 in gold, 11,728 ounces of silver, 4,296 pounds of copper, 164,254 pounds of lead, and 87,213 pounds of zinc, valued in all at $23,238, or $25.62 in metals a ton. Most of the output was lead-zinc ore from the Prince of Wales property, operated under lease by the Alta Tunnel & Transportation Co. The ore was treated in the company's 50-ton concentration mill equipped with jigs and tables, and the lead-zinc concentrates were shipped to the flotation plant of the United States Smelting, Refining & Mining Co. at Midvale, where they were separated into lead concentrates and zinc concentrates. According to a report to the industrial commission 248 tons of concentrates were shipped, containing 2 ounces of gold, 7,685 ounces of silver, 2,954 pounds of copper, 109,962 pounds of lead, and 123,966 pounds of zinc. Very little development was done at the property during the year. The Cardiff Mining & Milling Co. did no work in 1929 as the surface plant was destroyed by snowslides, but a car of first-class sulphide lead ore was shipped by lessees. The company was a large producer of lead and silver from 1915 to 1927. The Tar Baby property was operated under lease by the Howell Mining Co., and a car of high-grade silver-lead ore was shipped to Midvale for smelting. A small quantity of lead ore from the Maxfield mine was jigged and the resulting concentrates were shipped to Murray for smelting. Development in 1929 consisted of 130 feet of drifting, 75 feet of raising, and 38 feet of sinking. A test lot of ore containing gold, silver, and lead was produced from the Lake Blanche prospect.

In the Little Cottonwood district the only producers in 1929 were the Mineral Veins Coalition Mines Co. and the Columbus Rexall mine. Most of the output was first-class smelting ore from the property of the Mineral Veins Coalition Mines Co. and consisted of sulphide copper ore, copper-lead ore, and oxidized and sulphide lead ore. According to a report to the industrial commission the company shipped 826 tons of ore containing 25 ounces of gold, 15,952 ounces of silver, 57,986 pounds of copper, and 140,086 pounds of lead. Several cars of first-class oxidized copper ore and lead ore were shipped from the Columbus Rexall mine.

Bingham or West Mountain district.—In 1929 mines of the Bingham district produced ore and a small quantity of old tailings yielding on the average $3.71 in metals a ton, compared with $3.16 in 1928. Shipments of first-class ore amounted to 203,035 tons, compared with 159,052 tons in 1928; the output of concentrating ore was 18,312,047 tons, compared with 17,092,654 tons in 1928; and the quantity of concentrates produced was 645,106 tons, compared with 623,722 tons in 1928. The ore of smelting grade, amounting to 203,035 tons, consisted chiefly of copper and lead sulphides and siliceous silver ore; it yielded 23,249.88 ounces of gold, 1,373,136 ounces of silver, 8,153,635 pounds of copper, and 23,038,685 pounds of lead, valued in all at $4,098,976, or $20.19 a ton. The milling ore (18,312,047 tons) produced 645,106 tons of copper, lead, zinc, iron, and copper-lead concentrates, yielding 137,739.51 ounces of gold, 3,271,214 ounces of silver, 296,924,197 pounds of copper, 75,846,787 pounds of lead, and 43,588,545 pounds of zinc, valued in all at $64,504,736, or $99.99 in metals to a ton of concentrates. In addition copper precipitates recovered from mine water and from leaching of ore in place yielded 6,812,905 pounds of copper, valued at $1,199,071, and old tailings containing chiefly lead and silver yielded metals valued at $1,144.

Mine production of gold, silver, copper, lead, and zinc in Bingham or West Mountain district, Utah, 1928 and 1929, and total, 1865–1929, in terms of recovered metals

Year	Mines producing	Ore and old tailings	Gold	Silver	Copper [1]	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1928	20	17,251,706	$2,910,882	3,728,942	[2] 287,684,950	104,750,662	44,492,643	$55,308,535
1929	20	[3] 18,515,213	3,328,035	4,644,955	[4] 311,891,841	98,894,016	43,588,545	69,803,927
Total, 1865–1929	-------	(5)	[6] 55,774,429	[6] 79,864,657	3,995,271,736	1,963,132,430	284,034,032	915,693,278

[1] Includes copper saved from precipitates.
[2] Includes 6,207,777 pounds of copper saved from precipitates.
[3] Includes 131 tons of old tailings sold to a smelter.
[4] Includes 6,812,905 pounds of copper saved from precipitates.
[5] Figures not available.
[6] Includes placer production.

NOTE.—Total dividends, 1865–1929, $216,897,663.

Mine production of gold, silver, copper, lead, and zinc in Bingham or West Mountain district, Utah, in 1929, by classes of ore, in terms of recovered metals

Class of ore	Mines producing	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	7	[1] 12,685	812.23	145,653	212,836	707,619	------------
Copper	10	17,883,097	135,148.22	1,478,720	[2] 307,360,736	616,000	------------
Lead	14	[3] 99,645	6,119.91	988,577	1,004,065	25,186,481	------------
Copper-lead	1	43,870	1,175.15	67,830	863,314	1,861,041	------------
Lead-zinc	12	475,916	17,738.18	1,964,175	2,450,890	70,522,875	43,588,545
	[4] 20	18,515,213	160,993.69	4,644,955	311,891,841	98,894,016	43,588,545

[1] Includes 120 tons of old tailings sold to a smelter.
[2] Includes 6,812,905 pounds of copper saved from precipitates.
[3] Includes 11 tons of old tailings sold to a smelter.
[4] A mine producing more than one class of ore is counted but once in arriving at total for all classes.

According to its annual statement, the Utah Copper Co.[9] during 1929 produced 17,724,100 tons of copper ore, the largest output ever made; the ore contained 0.994 per cent of copper, or 19.89 pounds a ton. This low-grade material was mined by electric shovels and treated at the Magna and Arthur flotation plants. Metals recovered from concentrates during 1929, together with 4,420,460 pounds of copper precipitated from mine waters, amounted to 296,625,554 pounds of copper, 1,050,075 ounces of silver, and 116,087.18 ounces of gold, valued in all at $52,563,219. The copper concentrates shipped to the smelter averaged 32.06 per cent of copper in 1929, compared with 31.53 per cent in 1928. The management took advantage of the increase in the price of copper by operating at capacity the large mills at Magna and Arthur. The company was not only the largest producer of copper and gold in Utah in 1929 but ranked fifth in the production of silver, eighth in zinc, and ninth in lead. The company also did about 7,000 linear feet of development in the underground section of its property; this resulted in the shipment of 61,140 tons of sulphide lead-zinc ore, lead ore, and copper ore. Nearly half the output from this underground section was sulphide lead-zinc ore milled in the custom flotation plant at Midvale, and the remainder was chiefly first-class silver-lead ore of smelting grade.

After all operating charges of production, including the cost of marketing refined copper, were deducted the direct profits from mining operations for the year were $29,862,765, compared with $24,433,051 in 1928. Indirect earnings for the period, accruing as miscellaneous income incident to operations, amounted to $1,414,707 which, together with income of $6,261,051 from outside investments, made a total income of $37,528,523. The audit report shows deductions for other charges, including Federal income-tax accruals, depreciation of plant and equipment, and obsolescence or retirement of property, aggregating $3,878,143, leaving a net income carried to surplus account of $33,660,379, or approximately $20.72 per share of capital stock outstanding.

Dividends paid to stockholders in 1929 amounted to $20 a share, or a total of $32,489,800, the largest annual total ever paid. The aggregate distribution to stockholders to December 31, 1929, was $202,481,102.50, or $124.64 a share of present outstanding capital stock. A revised calculation of developed ore reserves on December, 31, 1929, as they will be mined, gave approximately 640,000,000 tons of milling ore averaging about 1.07 per cent of copper. The total ore mined to date was 193,868,751 tons; thus the total ore mined and to be mined, from the beginning of mining to the exhaustion of the estimated reserves, approximates nearly 834,000,000 tons.

The mining cost for a ton of ore milled, including a proper apportionment of fixed, general, and stripping charges (but not including Federal taxes and depreciation), was 41.21 cents, of which 22.44 cents represents stripping charges. This amount covered the cost of all stripping actually removed during the year and an apportionment of similar charges, previously deferred. The actual direct mining cost of all ore was 18.77 cents a ton, of which 12.37 cents represents all mine charges; the remainder (6.40 cents) represents overhead expense.

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[9] Utah Copper Co. Twenty-fifth Ann. Rept., for year ended Dec. 31, 1929.

The ore treated at the Magna and Arthur plants was 17,724,100 tons, about equally divided between the two mills and equivalent to a daily average of 50,210 tons. The average content of the ore was 0.994 per cent of copper, compared with 0.992 per cent in 1928; the average recovery in the form of concentrates was 85.67 per cent, or 17.04 pounds to the ton, compared with 85.56 per cent, or 16.97 pounds, in 1928. The average milling cost was 36.58 cents a ton, a decrease from 36.9 cents a ton in 1928.

The average cost per net pound of copper, with depreciation of plant and equipment and all fixed and general expenses (except Federal taxes) included, and gold, silver, and miscellaneous earnings credited, was 6.65 cents, compared with 6.38 cents, computed on the same basis, for 1928. The value of the gold and silver recovered and the miscellaneous earnings amounted to 1.45 cents per pound of copper, compared with 1.22 cents for 1928.

The meteoric waters percolating through the vast dump of stripping or overburden, generally referred to as waste dumps, dissolve a minute percentage of copper. These solutions were collected in conduits and pipe lines and conveyed to a central precipitating plant where 4,420,460 net pounds of copper was recovered at a cost of approximately 6.5 cents per pound. The new precipitation plant at the mouth of Bingham Canyon was completed in May and operated about seven months. It is described in an article[10] published in September. The company report continues:

> An aggregate of 5,075 feet of churn drilling done during the year in the northerly and westerly portions of the property developed additional positive ore amounting to 15,000,000 tons with an average grade of 1.12 per cent of copper. Indications are that the probable ore will amount to an additional 20,000,000 tons with a grade of about 1 per cent copper. * * *
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> The overburden excavated and disposed of during the year was 9,543,263 cubic yards, this being an increase of 10.53 per cent over any previous year.
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> * * *
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> The electrification of the mine haulage system was continued during the year by the addition of thirty eighty-five-ton electric locomotives, making a total of forty-one now in service. Steam locomotives are now in use at the mine only on some of the upper levels where the greater part of the material handled is short haul stripping. To furnish power for the additional locomotives, eight 1,000-kilowatt rotary converters with the necessary transformers and switching apparatus were installed.
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> Twenty-nine new buildings were added to the housing facilities for employees and their families at the company's new townsite at Copperton, thus extending the fully demonstrated advantages of this clean, sanitary, and pleasantly surrounded community.
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> At the mills, additional grinding and concentrating facilities were installed for the purpose of improving metallurgical results at a maximum tonnage capacity. The benefit of these betterments is reflected through a marked increase of copper recovery, all former plant records for low copper content in the tailings having been bettered since this supplemental equipment was placed in service.
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> * * *
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> During the month of April the mills treated a daily average of 61,744 dry tons of ore and produced 30,229,977 net pounds of copper—new high records for a single month's performance. The maximum tonnage of stripping and ore handled in a 24-hour day during the year was 142,185 wet tons, the greatest tonnage of ore mined and moved to the mills over the Bingham and Garfield Railway was 75,107 wet tons, and the highest tonnage milled was 69,200 dry tons, establishng new records for a 24-hour day. Yearly records were also established in ratio of concentration, per cent copper in concentrate, direct milling costs, and locomotive haulage cost at the mine.

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[10] Martin, Gail, A Modern Scrap-Iron Precipitation Plant: Eng. and Min. Jour., vol. 128, Sept. 21, 1929, p. 467.

From 1910 to 1929 the company treated 200,815,776 tons of ore and produced 1,598,906 tons of net copper. As in 1928, both the Magna and Arthur flotation plants were operated on an alkaline circuit. The grade of the copper concentrates continues to improve, and the cost of smelting is reduced by dropping a large part of the pyrite at both mills. The concentrates consisted chiefly of primary chalcopyrite, whereas the concentrates formerly made by the old wet concentration plants were largely chalcocite from the enriched area. An interesting paper [11] issued in February, 1930, reviews the history and general geology of the Utah Copper property and gives details on mining methods and costs.

The output of the United States Smelting, Refining & Mining Co.'s mines [12] at Bingham, including the Niagara property, amounted to about 216,500 tons of ore in 1929, an increase of about 28,500 tons over that in 1928. The output of lead-zinc ore from the Niagara mine was more than double that in 1928, but there was a decrease in the output of lead-zinc ore from the original property of the United States Smelting, Refining & Mining Co.; the output of first-class copper ore from the latter property, however, increased considerably. With the exception of a little more than 36,000 tons, the entire output was lead-zinc ore treated at the flotation plant at Midvale, which separates the galena-sphalerite-pyrite ore into lead, zinc, and iron concentrates. Both the lead and the iron products were treated locally at the Midvale lead smelter, and the zinc concentrates were shipped to Anaconda and Great Falls, Mont. Direct smelting ore consisted of 36,000 tons of first-class sulphide copper ore, oxidized lead ore, and siliceous gold and silver ore; most (about 87 per cent) of the smelting ore was copper ore. The Old Jordan-Telegraph-Last Chance group and the Niagara mine are opened at depth through the Niagara and Butterfield tunnels. In the former property 14,915 feet of drifting and 2,617 feet of raising were done in 1929, and in the Niagara mine 2,179 feet of drifting and nearly 300 feet of raising were done.

Details regarding production and the developed ore reserves are not published in the company's printed annual report, but the statement given to the industrial commission credited the main group with an output of 206,089 tons of first-class and milling ore containing 17,578 ounces of gold, 776,610 ounces of silver, 2,254,000 pounds of copper, 33,607,232 pounds of lead, and 30,449,735 pounds of zinc, valued in all at $2,116,059. After various charges, including the cost of extraction, freight and smelter charges, and cost of repairs, were deducted the net profit was $144,532. The Niagara Mining Co., controlled by the United States Smelting, Refining & Mining Co., made no report to the industrial commission, but the output of ore and the production of all metals in 1929 were decidedly increased. The company report continues:

> Production at the mines at Bingham was larger than in 1928; and this, together with the production of the newly acquired mines, served to increase the output of the reduction works at Midvale. Exploration and development at these properties have been gratifying and will be aided greatly by the combination of holdings through the acquisition of new properties, making it possible to do more intensive exploration work in the combined territory under one operating control.

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[11] Soderberg, A., Mining Method and Costs at the Utah Copper Co., Bingham Canyon, Utah: Inf. Circ. 6234, Bureau of Mines, February, 1930, 23 pp.

[12] United States Smelting, Refining & Mining Co. Twenty-fourth Ann. Rept., for year ended Dec. 31, 1929.

> Operating costs at both mines and reduction works were reduced and the results for the year show a satisfactory improvement over the preceding year.
>
> Investment in property acquired from the Bingham Mines Co. represents the purchase in July, 1929, of all the assets of that company as a going concern, subject to its liabilities, for 50,000 shares of the common stock of your company. The property acquired includes certain producing mines in the Bingham and Tintic districts of Utah; and also includes controlling stock interests in a number of mining properties in the above mentioned districts having possibilities of development but of lesser present importance. The 50,000 shares of common stock paid for these assets were valued at par, or $2,500,000, the excess cost being the liabilities of the Bingham Mines Co. assumed and liquidated by your company.

The Dalton & Lark, Commercial, Winnemuck & Dixon, etc., properties of the Bingham Mines Co. at Lark and Bingham were purchased by the United States Smelting, Refining & Mining Co. in July, and the group of mines at Lark became the Lark unit of the United States Smelting, Refining & Mining Co. The properties were worked the first seven months of the year by the Bingham Mines Co. and the last five months by the United States Smelting, Refining & Mining Co.; the two companies mined a total of about 61,000 tons of ore, more than half of which was lead-zinc ore milled in the custom flotation plant at Midvale; the remainder was chiefly first-class oxidized silver-lead ore of smelting grade. In 1928 nearly all the ore from the Lark group was shipped for smelting, and the zinc was lost in the slag.

In 1929, however, a large quantity of ore of this class was milled to make both lead and zinc products. It should be noted that the published figures do not represent the contents of the concentrates made; they represent the contents of both the first-class ore and the milling ore, chiefly the latter. The output of ore and the production of all metals, except copper, increased considerably; the increase in lead and zinc was especially notable. Development in 1929 consisted of nearly 6,400 feet of drifting and more than 600 feet of raising. According to a report given to the industrial commission the 61,233 tons of smelting ore and mill ore shipped from the Lark group contained 1,909 ounces of gold, 541,344 ounces of silver, 1,073,447 pounds of copper, 13,909,638 pounds of lead, and 4,714,744 pounds of zinc, valued in all at $1,288,044; after various charges, including cost of extraction, freight and smelter charges, and cost of repairs were deducted, a net profit of $269,232 remained. The United States Smelting, Refining & Mining Co. (including the properties of the Bingham Mines Co. at Bingham, Lark, and Eureka) ranked first in the production of lead in Utah in 1929, second in gold and zinc, and fourth in silver and copper.

The Utah-Delaware Mining Co. worked the Highland Boy and Yampa groups at the head of Carr Fork and produced 196,203 tons of ore, an increase of 25,441 tons over the output in 1928. The output of copper ore was more than double that in 1928, and there was also a decided increase in lead ore, but lead-zinc ore decreased considerably. About 45 per cent of the mine output was copper ore of milling and smelting grade, more than 38 per cent was lead-zinc mill ore, and most of the remainder was sulphide lead ore of milling grade. An aerial tramway takes the ore, as well as some custom material from Bingham, to the International mill and smelters. The property ranked second in the production of copper, fifth in gold, sixth in zinc, and seventh in lead in Utah in 1929. The mine is extensively developed, and in 1929 more than $200,000 was spent in drifting, crosscutting, and other work. Details regarding ore reserves and costs are not made public. The contents of the smelting ore and the milling ore from the Utah-Delaware mine as reported to the industrial commission follow: 14,843 ounces of gold, 403,683 ounces of silver, 5,461,275 pounds of copper, 17,369,460 pounds of lead, and 5,419,410 pounds of zinc. The metal output represents a marked decrease in lead, zinc, and silver, but a decided increase in copper and gold, compared with that in 1928, when the property produced 170,762 tons of ore containing 10,282 ounces of gold, 496,577 ounces of silver, 2,999,185 pounds of copper, 27,137,426 pounds of lead, and 11,056,881 pounds of zinc.

The mine and mill of the Utah-Apex Mining Co. were operated the entire year, and the company paid a dividend of $264,100, making a total of $3,500,000 paid to date. The output of first-class smelting ore, which was chiefly sulphide copper ore, increased nearly 20 per cent in 1929, but the milling product decreased nearly 5 per cent. The largest decrease was in lead-zinc ore milled and consequently in the production of lead and zinc. The milling product consisted chiefly of lead-zinc ore that was reduced to lead concentrates and zinc concentrates and copper-lead ore that was reduced to copper-lead concentrates. According to a report to the Bureau of Mines for the calendar year 1929 the company produced 191,795 tons of ore, of which 35,182 tons was shipped to the smelters and 156,613 tons (112,743 tons of lead-zinc ore and 43,870 tons of copper-lead ore) was milled. The copper-lead concentrates—4,887 tons—contained 1,175.15 ounces of gold, 67,830 ounces of silver, 1,079,143 pounds of copper, and 1,953,727 pounds of lead. The lead concentrates—11,800 tons—contained 1,793.60 ounces of gold, 207,848 ounces of silver, 715,080 pounds of copper, and 14,386,840 pounds of lead. The zinc concentrates—8,107 tons—contained 313.22 ounces of gold, 19,027 ounces of silver, 254,845 pounds of copper, 344,793 pounds of lead, and 8,225,225 pounds of zinc.

The first-class smelting ore consisted of 32,567 tons of sulphide copper ore (containing 2,957.13 ounces of gold, 101,392 ounces of silver, and 2,469,043 pounds of copper) and 2,615 tons of sulphide lead ore (containing 135.91 ounces of gold, 16,455 ounces of silver, 83,439 pounds of copper, and 750,204 pounds of lead). The company reported to the industrial commission a total of 191,795 tons of ore extracted and gave the contents of the crude ore and concentrates shipped as 6,325 ounces of gold, 409,552 ounces of silver, 4,601,550 pounds of copper, 17,043,440 pounds of lead, and 9,441,272 pounds of zinc. In 1929 the company ranked third in Utah in the production of copper, fifth in zinc, sixth in lead, and seventh in gold. The mine is developed by a main vertical shaft 2,400 feet deep, a winze 800 feet deep, and various drifts, raises, and tunnels. In 1929 development consisted of 10,000 feet of drifting and raising. The improved flotation plant in Carr Fork near Bingham has a capacity of 700 tons of ore a day but treated only 429 tons a day; the ore contains chiefly sphalerite, chalcopyrite, galena, and bornite. The following notes are taken from the company's report for the fiscal year ended August 31, 1930:

> The operating problem during the year has been largely one of keeping pace with the drastic reductions in metal prices. During the first five months of the

year an attempt was made to meet this situation by reducing operating costs through increased production. While operating costs were reduced materially, yet the grade of our product suffered proportionately and the results were not satisfactory; and thereupon it was decided to reduce our output by selective mining and thereby also further reduce overhead expense. Hence, operations on company account were discontinued and mining operations were continued for the balance of the year entirely by leasing methods whereby employees became lessees. * * *

What appears to be a large body of low grade copper ore, assaying from 2 per cent to 3 per cent copper has been found between the 2,900 and 3,100 levels. However, under present market conditions this ore can not be classed as of commercial grade.

The exploration work done on all levels in the various parts of the mine during the year has been successful only in picking up minor ore shoots with the exception of work done on the 1,150 and 1,300 levels in the Parvenu zone. Here a small new lead-zinc ore body has been found with ore assaying from 12 per cent to 20 per cent of lead and 8 per cent to 12 per cent of zinc.

The company's ore reserves may be estimated as follows: 50,000 tons of 12 per cent lead ore, 10,000 tons of 3 per cent to 4 per cent copper ore, and 200,000 tons of 2 per cent to 3 per cent copper ore.

For the fiscal year ended August 31, 1930, the company received $978,396 from the sale of ore, from royalties, etc. Mining, milling, and development cost $850,682; after general expenses were paid a loss of $217,469 was given before providing for depletion and the Federal income tax.

Leaching of ore in place continued during 1929 at the property of the Ohio Copper Co. [13] at Lark. In 1929 the output of copper recovered from precipitates was 2,215,178 pounds, recovered at a cost of 14.061 cents a pound, compared with 3,973,282 pounds in 1928. The operating profit was $88,099 which, when added to a miscellaneous income of $29,509, made a total gross income in 1929 of $117,608, compared with $145,039 in 1928. The net profit before depreciation and depletion was $26,829. A car of high-grade copper ore containing gold and silver was shipped from the limestone area of the mine, in which most of the work of the year was done. The company's report continues:

During the year, there was expended the sum of $161,591.35 in the exploration and development of the limestone beds of copper-gold and lead-silver ores, and on experiments conducted with a view to the retreatment of over 4,000,000 tons of the material contained in the tailings dump of the old mill. * * *

The object of the development has been to prospect the limestone beds that have yielded many million dollars in profits from ores in adjoining properties in the Bingham district. These limestones come to the surface far south and east of the Ohio property. Their northerly dip brings them into the Ohio many hundred feet underground. * * *

Before the beginning of the year 1929 diamond drilling had proved that these limestone beds are mineralized with iron, copper, and lead sulphides, carrying gold and silver values. It remained to find these sulphides in bodies of commercial size and grade. A three-compartment inclined shaft had been sunk to the 700 level, and a crosscut had been run north to a point where drilling had disclosed a narrow band of rich lead-silver ore in the bottom of the commercial limestone.

During 1929, the two main limestones were partly developed on the 700 level by underground work and diamond drilling. The amount of development was as follows: 4,547 feet of drifting and crosscutting, 583 feet of raising, 31 feet of winzing, and 1,977 feet of diamond drilling. * * *

Over half the development has been in the upper, or Commercial Limestone. Several mineralized fissures have been found cutting this limestone. The greater part of the work was done along a steep northeast fissure that cuts the bottom of the Commercial Limestone on the 700 level. * * *

A south crosscut on the 700 level has developed the lower, or Jordan Limestone. A strong northwest fissure cuts this limestone. At the intersection of

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[13] Ohio Copper Co. of Utah Ann. Rept. for year ended Dec. 31, 1929.

> the fissure zone with the bottom beds of the Jordan, there is a large mass of sulphide. At the end of the year, this sulphide had been developed for a length of 150 feet along the bedding and a width of from 5 to 50 feet. * * *
>
> During the year flotation experiments were carried on * * * to prove whether or not the Ohio tailings dump can be retreated at a profit. The problem was difficult, because of the presence of a considerable quantity of oxidized copper. * * *
>
> If, as seems probable, these results can be equalled in a large mill, the cost per pound of copper recovered should be only 10 to 10.5 cents. The most economical mill will be one with 1,700 tons per day capacity, which is all that the available water will handle without recovery of water from tailings. * * *
>
> Before building the large mill, a small pilot plant will be erected to check the laboratory results and to determine the best way of moving the tailings to the mill.

The ore output of the Utah Metal & Tunnel Co. in 1929 was 32,813 dry tons, an increase of nearly 3,000 tons over 1928. The ore had a gross value of $286,936, compared with $264,084 in 1928. Nearly all the output was lead-zinc ore carried by an aerial tramway to International for milling. Development in 1929 under the management of the Utah-Delaware Mining Co. consisted of 6,804 feet of work, chiefly in drifts and crosscuts, compared with 5,350 feet in 1928. The company received $286,936 from the sale of ore and $26,589 from other sources, chiefly the sale of water, which made a total income of $313,525. After $128,692 was deducted for mining, $59,015 for surface repairs, ore hauling, etc., $44,112 for smelter charges, and $13,088 for taxes, an operating profit of $68,618 remained. Development costs, including interest on money advanced for development, were $154,810; the net loss, including charges for depletion and depreciation, was $125,836. The annual report of the company gives the following ore output for 1929: 32,813 tons of first-class smelting ore and milling ore, which yielded 2,489 ounces of gold, 114,160 ounces of silver, 363,199 pounds of copper, 3,651,873 pounds of lead, and 1,872,466 pounds of zinc. An increase was reported in the production of all the metals except lead. The report says:

> The development work of the past year, with that done in other years, has placed the property in an excellent position to carry on the development of the entire property.
>
> There was driven a total of 6,804 feet of development work. Of this 5,130 feet were driven in developing the Washington and Levant lime beds on the east side of Occidental fault, 1,674 feet were driven to develop the region on the west side.
>
> A total of 710 feet of diamond drilling was done for location of formations.
>
> The Washington lime bed, which was opened in 1927, has been the main source of production and development work shows that the ore continues at depth, having been opened up on the 1,800-foot level. * * *
>
> During the year extensive repairs were made in No. 1 tunnel and to the surface plant. * * *
>
> The company has some twenty-five leasers working in old stopes, from which they are shipping approximately 100 tons a day.
>
> The Utah Delaware Mining Co. under its agreement with this company is continuing the development work and it is hoped that under their able management high grade ore will be found. * * *
>
> In March, 1930, the company sold its water rights to the Utah Copper Co. for $275,000.

The contents of the smelting and milling ore from the property of the Utah Metal & Tunnel Co., as reported to the industrial commission, were 2,732 ounces of gold, 126,931 ounces of silver, 452,925 pounds of copper, 4,553,927 pounds of lead, and 3,144,364 pounds of zinc.

An interesting development in the Bingham district in 1929 was the increase in the output of ore from the Extra Session property near Lark, operated by the Bingham Prospect Mining Co. The output increased from 4,000 tons in 1928 to 27,928 tons in 1929 and consisted in 1929 of 14,998 tons of oxidized silver-lead ore and 2,233 tons of first-class siliceous silver ore of smelting grade and 10,697 tons of zinc-lead sulphide ore milled at Midvale. These ores contained 1,113.57 ounces of gold, 984,877 ounces of silver, 181,862 pounds of copper, 7,100,688 pounds of lead, and 4,089,096 pounds of zinc. The net smelter receipts from the sale of the ore were $628,230, compared with $75,785 in 1928. The property was opened and operated through an inclined shaft, but in 1929 a working tunnel was driven to connect with the level of the railroad tracks above Lark. The mine has been developed into a large and regular producer; in 1929 it ranked sixth in the production of silver in Utah, ninth in zinc, and thirteenth in lead.

The Montana-Bingham Consolidated property, including the Tiewaukee mine, controlled by the Bingham Mines Co., was purchased in July by the United States Smelting, Refining & Mining Co. No development was done during the year, but lessees shipped from the dump eight cars of siliceous ore containing chiefly silver, lead, and gold.

The output of ore from the New England property, owned by the Bingham Metals Co., decreased from 3,800 tons in 1928 to 1,573 tons in 1929. Most of the material in 1929 was first-class sulphide lead ore; the remainder was lead-zinc ore and siliceous gold ore. The mine is opened by an inclined shaft and six levels; in 1929 more than 1,700 feet of work was done in drifts, crosscuts, and raises. The company's report to the industrial commission gave 1,573 tons of ore, including both milling ore and first-class smelting ore, which contained 323 ounces of gold, 12,564 ounces of silver, 7,647 pounds of copper, 424,268 pounds of lead, and 157,250 pounds of zinc. This output represents a marked decrease, except in lead, compared with that in 1928, when the property produced 3,407 ounces of gold, 30,373 ounces of silver, 87,797 pounds of copper, 412,512 pounds of lead, and 336,625 pounds of zinc.

The output of the Park-Bingham Mining Co., which controls the old Silver Shield and Bully Boy properties, decreased from 8,900 tons in 1928 to 1,826 tons in 1929. Nearly all the output in 1929 was lead-zinc-iron ore milled at Midvale. The property was formerly operated through raises from the Butterfield tunnel, but the company reconditioned the old Silver Shield shaft in 1929 and used it for operations early in 1930.

The New Bingham Mary Mining Co. was organized in 1929 to operate property near the Utah-Apex mine. Several hundred tons of lead-zinc ore was treated in the flotation plant of the Utah-Apex Mining Co., where it was separated into lead concentrates and zinc concentrates, and several cars of first-class lead ore were shipped to Murray for smelting. Other producers in the West Mountain district were the Queen (Lavagnino group), Castro (Nick Floor Mining Co.), and Osceola-Lucky Boy properties. Several operators at Bingham made copper precipitates for smelting by running copper-bearing water over scrap iron, and several cars of old tailings were shipped from various dumps.

At Garfield the American Smelting & Refining Co. operated its copper smelter on custom material from Utah, California, Nevada, Idaho, Colorado, and Arizona; the material was chiefly copper concentrates from the mills of the Utah Copper Co. Shipments of copper bullion in 1929 averaged about 27,000,000 pounds a month.

Smelter district (*Midvale and Murray*).—The output of the Smelter district in 1929 consisted of 12 tons of old matte shipped from the smelter dump at Sandy; the material contained chiefly silver, lead, and copper.

At Midvale the lead smelter of the United States Smelting, Refining & Mining Co.[14] treated custom ore and concentrates from Arizona, California, Colorado, Idaho, Montana, Nevada, Oregon, and Utah, producing about 40,000 tons of lead bullion, an increase of about 500 tons compared with 1928. The smelter is equipped with seven blast furnaces, bag house, Cottrell plant, and Dwight-Lloyd sintering machines. The products, in addition to the usual shipments of lead bullion and lead-copper matte, are refined arsenic, weed killer, and cadmium. From 1919 to 1927, according to the company's annual reports, the works produced 354,248 tons of lead bullion, an average of 39,361 tons a year; no exact figures are given for 1928 and 1929 relative to the bullion output or its metal content.

The new flotation plant at Midvale, a modern steel and concrete structure, treated on the average 780 tons of lead-zinc-iron ore a day, a slight increase over the average feed in 1928. From 1919 to 1929 this new flotation mill and the old wet concentration mill treated about 2,030,300 tons of ore, chiefly from the company's mines at Bingham. The company report says:

> The entire output of lead bullion from the Midvale smelter was treated at the company's electrolytic lead refinery at East Chicago, Indiana. A further substantial reduction in refining costs was achieved during the year.

At Murray the American Smelting & Refining Co. operated its lead plant, equipped with sampling mills, roasters, bag house, and blast furnaces; the bullion output in 1929 increased about 3,500 tons compared with 1928. This plant has been in operation more than 21 years and was so well planned originally that it has adjusted itself conveniently to the many changes made during the period, particularly in the roasting devices. Lead bullion is shipped East for refining, lead-copper matte to the copper plant at Garfield owned by the same company, and arsenic dust to Colorado and California. Salt Lake City is the center for three large lead smelters and two copper plants, but no refining is done locally.

SAN JUAN COUNTY

Big Indian district.—In 1929 a new 100-ton flotation mill was constructed on the property of the Big Indian Copper Co., and several hundred tons of oxidized copper ore was treated. Copper concentrates and first-class crude ore were hauled 70 miles to Thompsons, the nearest shipping point on the Denver & Rio Grande Western Railroad. The ore occurs in sandstone and contains about 3.5 per cent of copper. The chief minerals are malachite and azurite, with a little native copper. The mill is equipped with a jaw crusher,

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[14] United States Smelting, Refining & Mining Co. Ann. Rept. for 1929.

Symons disk crusher, ball mill, Dorr classifier, 3 Parker flotation machines, thickeners, and an Oliver filter. The mill recovers about 85 per cent of the copper in concentrates containing about 35 per cent of copper.

Red Canyon district.—Gold bullion valued at $800 was recovered by several operators working placer properties in Red Canyon and bars on the Colorado River, near Blanding.

SEVIER COUNTY

Redmond district.—The Salina Lead-Zinc Co., owning several claims 2¼ miles east of Redmond post office, did considerable development in 1929 and shipped one car of first-class oxidized zinc ore to an eastern zinc plant. The property is opened by a vertical shaft 500 feet deep and by 1,000 feet of drifts.

SUMMIT AND WASATCH COUNTIES

PARK CITY REGION

The Blue Ledge and Snake Creek districts in Wasatch County and the Uintah district in Summit County represent the producing area of the Park City region.

Mine production of gold, silver, copper, lead, and zinc in Park City mining region, Utah, 1928 and 1929, and total, 1870–1929, in terms of recovered metals

Year	Mines producing	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1928	14	[1] 731, 103	$542, 308	6, 745, 826	2, 639, 492	82, 854, 090	47, 569, 849	$12, 576, 001
1929	11	[2] 777, 909	428, 364	6, 157, 501	2, 524, 324	85, 139, 968	55, 929, 712	13, 209, 772
Total, 1870–1929	-------	(3)	7, 688, 902	195, 189, 175	52, 383, 734	1, 896, 821, 589	293, 221, 118	280, 463, 888

[1] Includes 187,660 tons of old tailings.
[2] Includes 251,228 tons of old tailings.
[3] Figures not available.

NOTE.—Total dividends, 1870–1929, $62,996,232.

Mine production of gold, silver, copper, lead, and zinc in Park City mining region, Utah, in 1929, by classes of ore, in terms of recovered metals

Class of ore	Mines producing	Ore and old tailings	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	4	[1] 10, 265	395. 27	238, 531	49, 807	211, 390	----------
Lead	4	2, 825	120. 23	64, 455	32, 731	855, 866	----------
Copper-lead	1	[2] 72	2. 88	563	4, 000	7, 000	----------
Lead-zinc	8	[3] 764, 747	20, 203. 73	5, 853, 952	2, 437, 786	84, 065, 712	55, 929, 712
	[4] 11	777, 909	20, 722. 11	6, 157, 501	2, 524, 324	85, 139, 968	55, 929, 712

[1] Includes 1,156 tons of old tailings sold to a smelter.
[2] Old tailings sold to a smelter.
[3] Includes 250,000 tons of old tailings concentrated.
[4] A mine producing more than one class of ore is counted but once in arriving at total for all classes.

The production of gold and silver in the Park City region was much less than that in 1928, but the production of lead and zinc increased considerably; copper decreased slightly. The metal output of the Park Utah Consolidated Mines Co. was decidedly less, but the decrease in lead and zinc was offset by the increase in the output of lead-zinc ore from the Silver King Coalition and New Quincy mines. Milling of ore in the region is done chiefly at the modern 800-ton flotation plant of the Silver King Coalition Mines Co. The Judge mill treated ore from the Daly, Daly Judge, and Daly West mines; it is primarily a wet concentration plant and makes lead concentrates, which are shipped for smelting, zinc-iron middlings, which are re-treated at the International custom flotation plant, and flotation lead concentrates from primary slimes.

The Silver King Coalition Mines Co.[15] produced 312 tons of first-class ore (including 93 tons of lease ore), which was shipped for direct smelting, and 179,989 tons of second-class or mill ore—a total of 180,301 tons. The output of first-class shipping ore decreased appreciably, but there was a notable increase in the output of milling ore, resulting in a general increase in the recovered gold, silver, copper, lead, and zinc. After smelter and freight charges were deducted the company received $4,088,419 from sales of ore and concentrates; after other income ($68,749) was added the total income for the year was $4,157,168. After $1,983,133 was deducted for mining and milling costs, $274,815 for taxes, and $150,612 for other charges (including $92,629 for depreciation), a net income of $1,748,608 remained. Although the company spent a record amount for development and paid its largest dividend disbursement an addition of more than $284,000 was made to the surplus, which was $2,927,899 on December 31, 1929. The milling ore yielded 34,542 tons of lead concentrates and 14,642 tons of zinc concentrates. The mine became the largest producer of silver in Utah in 1929 and ranked second in the production of lead, third in zinc, and sixth in copper. The accompanying table gives the average metal contents of all products from the property.

Gold, silver, copper, lead, and zinc contained in products of Silver King Coalition mine, Utah, in 1929

Kind of material	Gold		Silver		Copper		Lead		Zinc		Net smelter returns
	Total	Per ton	Total	Per ton	Total	Per cent	Total	Per cent	Total	Per cent	
	Ounces	*Ounce*	*Ounces*	*Ounces*	*Pounds*		*Pounds*		*Pounds*		
First-class ore	9.83	0.0449	12,817	58.53	6,828	1.56	185,304	42.31			$14,153
Lead concentrates	3,234.28	.0936	2,796,873	80.97	1,693,818	2.45	43,172,889	62.49			3,590,567
Zinc concentrates	240.73	.0164	177,338	12.11	145,571	.50	921,337	3.15	16,032,194	54.75	481,553
Lessees' ore	14.55	.1581	6,165	67.01	1,428	.78	83,327	45.29			2,146
	3,499.39		2,993,193		1,847,645		44,362,857		16,032,194		4,088,419

During the year $513,497 was spent in development (33,105 feet of drifting, raising, and sinking). Dividends of $1,464,560 were paid in 1929, and a dividend of $305,117 was declared payable on January

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[15] Silver King Coalition Mines Co. Ann. Rept. for year ended Dec. 31, 1929.

2, 1930, making a total of $24,330,698. The amount paid in dividends in 1929 was the largest disbursement since the organization of the present company in 1907. The milling equipment, similar in general to the latest flotation plants for lead-zinc ore, consists chiefly of a gyratory crusher, a Symons cone crusher, 3 ball mills, 3 classifiers, 28 MacIntosh flotation machines, and 2 Oliver filters. The company report says:

> There was a material increase in the total production, and in value per ton of ore produced, an increased metal content in both the zinc and lead concentrates, as well as the increased net smelter returns to your company. These, of course, have resulted in the greater net profits shown for the year.
>
> Due to the installation of additional equipment and the continued improvement in our selective flotation milling methods, we are now able to profitably mill practically all the ores produced, thus almost entirely eliminating the shipment of so-called first-class ores—there being only 312 tons of such shipped during the year. This improved milling efficiency is the result of the past several years' program of research and experimental work that has been under way in our mill. * * *
>
> During the past year there has been 33,105 feet of development work completed at a cost of $513,497.42 and, as a result of this development program, ore reserves have been substantially increased by establishing the extension and continuity of the old and proven ore channels that have been productive for many years. What appears to be a new and separate ore channel, known as the A. K., has been discovered along a fissure system that has never heretofore been explored to any extent in the property. During the short period of time that exploration work has been carried on in this undeveloped territory a very material tonnage of exceptionally high grade ore has been blocked out and added to the ore reserves, and at this time, I believe it is safe to predict a profitable future production of high grade ore from this section of your property.
>
> For betterments and new equipment the sum of $227,252.61 was expended during the year. Most important was the construction of a new compressor building at the portal of the Silver King Consolidated tunnel to house a new air compressor of 3,200 cubic feet displacement. * * * At the mill, extra flotation cells were installed; a new 120-foot diameter concrete Dorr thickening and dewatering tank was erected and miscellaneous other equipment put in—all contributing to increased mill recoveries and a reduction in operating costs.
>
> The holdings of the company consist of 4,276 acres of patented ground. This extensive acreage, only a small percentage of which has been so far prospected, should insure an additional long life to the company. The large tonnage of ore developed and blocked out in advance will permit increased production at any time without any material hazard of decreasing the present ore reserves.

The Park Utah Consolidated Mines Co. operated the Park City unit, consisting of the Daly West and Daly Judge properties, and the Park Utah unit, near Keetley, in the eastern part of the district in Wasatch County. The metal output from the Park Utah mine, as well as the production from the Park City unit, was much less than that in 1928. The chief output of the Park Utah mine is lead-zinc ore, which is loaded on Union Pacific cars at Keetley and shipped to International for milling. It is there separated into zinc concentrates, which are shipped to the electrolytic plants of the Anaconda Copper Mining Co. at Black Eagle and Anaconda, Mont., for leaching, and into lead concentrates and iron concentrates, which are smelted at International, Utah. Besides gold and silver, the milling ore contains about 4.65 per cent of lead, 6.68 per cent of zinc, and 0.24 per cent of copper. The Judge mill in Empire Canyon, which treats ore from the Daly, Daly West, and Daly Judge mines, is a wet concentration plant, including a few flotation cells used on primary slimes; the products are lead concentrates of smelting grade and zinc-iron middlings which are re-treated by flotation at International. An aerial tramway takes the first-class ore and the mill products to the loading station at Park City.

According to the annual report of the Park Utah Consolidated Mines Co. for 1929 the combined output of all mines—including the Ontario and Daly properties which comprise separate corporations—amounted to 300,931 tons of ore; ore and concentrates shipped contained 25,387 ounces of gold, 2,759,678 ounces of silver, 1,229,051 pounds of copper, 40,784,284 pounds of lead, and 48,708,381 pounds of zinc. There was a large decrease in the quantity of ore milled and in its metal content. As in former years the zinc output given above not only includes zinc lost in milling but also zinc in lead products lost in smelting. The bulk of the ore was milled, and about 33,000,000 pounds of zinc was recovered from the zinc concentrates made at International. The total metal contents of the ore and concentrates shipped are shown in the table that follows.

Gold, silver, copper, lead, and zinc contained in ore and concentrates shipped from the properties under control of Park Utah Consolidated Mines Co., Utah, in 1929

Mine	Ore and concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Ounces*	*Ounces*	*Pounds*	*Pounds*	*Pounds*
Park City unit	123, 939	2, 619	698, 891	371, 427	25, 076, 930	26, 440, 995
Park Utah unit	163, 981	22, 401	1, 729, 709	783, 842	15, 139, 304	21, 616, 958
Ontario	13, 011	367	331, 078	73, 782	568, 050	650, 428
	300, 931	25, 387	2, 759, 678	1, 229, 051	40, 784, 284	48, 708, 381

The Park Utah Consolidated Mines Co., exclusive of the Ontario and Daly properties, was again the largest producer of zinc in Utah; the company ranked third in the production of gold and silver, and fourth in lead. Dividends paid to stockholders in 1929 amounted to $1,256,100. The dividends paid to date, including those paid by the Judge Mining & Smelting Co., the Park City Mining & Smelting Co., the Park Utah Consolidated Mines Co., and $3,172,500 paid by the Daly Mining Co., aggregate $23,585,362. The Ontario Silver Mining Co. has paid $14,157,500, making $37,742,862 paid by the companies now under the control of the Park Utah Consolidated Mines Co. The total metals contained in the crude smelting ore, concentrates, and milling ore of the property under control of the Park Utah Consolidated Mines Co. and the Ontario Silver Mining Co. from the date of discovery to January 2, 1930, are given as follows: 214,031 ounces of gold, 125,128,211 ounces of silver, 36,149,002 pounds of copper, 713,075,020 pounds of lead, and 365,052,981 pounds of zinc. Production was curtailed during the latter half of 1929 as a result of the low metal prices, but development work was extensive. A recent circular[16] gives details on mining methods and costs at the Park Utah mine. The following paragraphs are taken from the company's annual report:

> The net earnings from the operations of your company for the year 1929 were less than the earnings for the years immediately preceding. The several factors

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[16] Hewitt, E. A., Mining Methods and Costs at the Park Utah Mine, Park City, Utah: Inf. Circ. 6290, Bureau of Mines, June, 1930, 18 pp.

which were responsible for this condition were lower returns for the ore produced, a decrease of 10 per cent in the tonnage mined, and heavy expenditures for nonproductive work. * * *

The major single development operation of the year was to extend the lowest level of the Utah unit from the 1,800 to the 1,950 level in the search for the continuation of the ore bodies above. Much delay and considerable additional expense was caused in the early stages of this work because of heavy ground near the shaft. Large flows of water were expected and careful provision was made for the pumping of the water to the main drainage tunnel. The pumping plant, which was a result of this policy, has proved exceptionally efficient and of adequate capacity, and no delays have been experienced because of the nonremoval of water. However, the speed of driving was greatly retarded because of the sudden inflows in the headings. All levels above are now completely drained and it is unlikely that any large amount of additional water will be encountered. After crosscutting the fissure on the 1,950 level, it was found that the downward extension of the Western ore body was not vertical because of a change of rock formation present at this location. This condition does not exist either to the westward or eastward of the crosscut, and headings are now being driven in these directions. To the eastward ore has already been exposed one hundred feet in length and additional deposits are expected under the eastern ore body some distance ahead. Midway between the 1,800 level and the 1,950 level large deposits of ore have been proved. * * *

The City unit of the property produced 123,939 tons of ore during the year, and its large undeveloped territory continues to give every assurance of many years of major production. Most of the exploratory work in this unit has been toward the southwest where new ore bodies have been discovered to the west of any ore previously known, proving the continuity of the mineralization into the extensive acreage of ground owned by the company in that direction. A deposit of ore of major size recently developed below the 1,600 level in the main producing fissure of the property, has added an additional fertile area. The damage which resulted from the destruction by fire in June of the headframe and buildings of the main hoisting shaft, has been repaired. Fireproof reconstruction has been completed and the plant is again in operation. * * *

There has been a delayed response to development on the lower levels of the Utah unit, but the values already discovered, together with the heavy mineralization of the veins, present a favorable outlook for the success of development work now under way.

The Park Utah Consolidated Mines Co. received $2,808,089 in 1929 from the sale of ore and $77,383 from other income, making a total income of $2,885,472. After $1,633,357 was deducted for mining costs, $334,389 for development, $104,690 for milling, $94,944 for taxes, and $141,064 for other expenses, $577,028 remained before depreciation and depletion. A deduction of $109,306 was made for depreciation, leaving a net income for the year (exclusive of depletion) of $467,722, compared with $913,377 for 1928.

The Daly Mining Co., a separate incorporation controlled and operated by the Park Utah Consolidated Mines Co., produced about 1,300 tons of sulphide lead ore of smelting grade and mill ore treated at the Judge plant. The output was not given separately in the printed report. More than 1,100 feet of development was done in 1929, chiefly in drifting and crosscutting.

The Ontario Silver Mining Co., also controlled and worked by the Park Utah Consolidated Mines Co., shipped 13,011 tons of lead-zinc ore and siliceous silver ore; about two thirds of the output was lead-zinc ore milled in the flotation plant at International. The ore carries considerable silver and is highly siliceous but contains only small quantities of lead and zinc. Besides the lead-zinc ore and siliceous silver ore, 72 tons of old tailings was shipped for smelting. The mine was a large producer of silver, lead, and zinc in 1928, but in 1929 the production was less than half that in 1928. Operations were continuous and about 5,000 feet of drifting and raising was done, but the company reported a net loss of $66,758 for 1929. Ore in sight in the upper levels is limited.

An interesting feature of 1929 was the large increase in the production of lead-zinc ore from the New Quincy mine, owned by the New Quincy Mining Co. The mine was operated continuously, and 36,932 tons of lead-zinc ore was shipped to the custom flotation plant at International. The ore, which averaged 0.031 ounce of gold and 18 ounces of silver to the ton, 0.84 per cent of copper, 12.10 per cent of lead, and 12.81 per cent of zinc, was trammed 2½ miles to the Ontario loading station. The company received $630,328 from the sale of ore and $7,002 from other income, making a total income of $637,330 for the year; after $362,169 for various expenses was deducted the net profit was $275,161. The company paid its initial dividend, amounting to $143,336, in May and another of the same amount in November, making the total for the year $286,672. The property ranked fourth in the production of zinc in Utah in 1929, ninth in silver, and eleventh in lead. The report to the industrial commission gave the contents of the milling ore shipped as follows: 1,136 ounces of gold, 658,314 ounces of silver, 617,512 pounds of copper, 8,937,356 pounds of lead, and 9,461,671 pounds of zinc. The company's statement for 1929 contains the following paragraphs:

> Most of the ore came from the western end of the property. At the present time these ore bodies are pretty well depleted. There are two or three fissures in the western end of the mine on which we are doing some development work. The development work for the last three or four months has been confined largely to the eastern end of the New Quincy property and the newly acquired Little Bell property. * * *
>
> On the 700 level of the Little Bell we have opened up the Little Bell fissure to the east. * * *
>
> The balance of the work is being done on the eastern end of the New Quincy property which is within a couple of hundred feet of the property lines of the Little Bell. * * *
>
> Our 1,219 stope is producing a steady tonnage of fair grade ore. * * * We have had from eight to ten headings going steadily and have aimed to take out only enough ore to pay the expense of the development work but from now on we aim to increase our tonnage to set aside obligations which were made through the acquisition of the Little Bell property.

The Glencoe mine 3 miles south of Keetley was worked by the Park Galena Mining Co., which shipped 3,610 tons of lead-zinc ore to the custom flotation mill at Midvale. The company received $42,566 from the sale of milling ore, containing 368.33 ounces of gold, 41,868 ounces of silver, 31,916 pounds of copper, 823,133 pounds of lead, and 375,956 pounds of zinc. At the Midvale flotation plant of the United States Smelting, Refining & Mining Co. the ore is separated into lead, zinc, and iron concentrates. The property is opened by a vertical shaft 500 feet deep and by drifts and tunnels aggregating 4,600 feet; development in 1929 consisted of 1,150 feet of tunneling. A 100-ton flotation plant built early in 1928 was idle.

The Park City Consolidated Mines Co. operated its property east of Park City the entire year and shipped about 2,000 tons of siliceous silver ore in the course of development. The company owns or controls the Park City, East Ontario, St. Louis Ontario, Roosevelt, Gap, and Mountain Neef groups between Keetley and Park City; 5,909 feet of development was done in 1929 in drifting, sinking, and raising. Work was continued early in 1930, and sulphide ore was opened in the Silver fissure between the 800 and 1,000 foot levels.

Concentrates, containing chiefly zinc, from creek tailings obtained in Woodside Gulch below the Silver King Coalition mill and also in Empire Canyon below the Daly Judge mill were shipped from the two flotation plants operated by Charles Moore. Siliceous tailings containing chiefly silver were also shipped to Garfield for smelting. In the eastern section of the region near Keetley considerable development was done, chiefly at the Park Premier, Star of Utah, East Utah, Park King, and Mayflower properties.

TOOELE COUNTY

In Tooele County 24 mines produced 62,630 tons of ore, an increase of 13,914 tons over the output reported from 25 mines in 1928. The recovered gold increased from $77,886 to $135,222, the silver from 273,768 to 387,441 fine ounces, the copper from 167,143 to 329,750 pounds, and the lead from 14,773,417 to 23,599,238 pounds; the zinc decreased from 1,494,868 to 1,048,727 pounds. The total value of these metals increased from $1,210,154 to $1,955,732. The increase in total value was due chiefly to the notable increase in shipments of sulphide lead ore from the property of the Bluestone Lime & Quartzite Mining Co. near Stockton; there was also a good increase in the production of gold, silver, and lead, but a decrease in zinc, from the Honerine and Galena King properties of the Combined Metals Reduction Co.

At International, west of Bingham, the International Smelting Co., a subsidiary of the Anaconda Copper Mining Co., continued to operate its 1,200-ton flotation plant on sulphide ore, its 150-ton oxide mill, and its copper and lead smelting plants on custom ore. The copper plant is equipped with roasters, a Cottrell plant, 5 reverberatory furnaces, and 5 converters. The lead plant has 10 Dwight-Lloyd sintering machines and 5 blast furnaces. More ore was treated in the copper plant in 1929, but results at the lead plant were less because of decreased shipments from the Park City region.

The custom sulphide flotation plant at International treated about 424,000 tons of ore from Utah, Idaho, and Nevada, making lead concentrates, copper concentrates, and iron concentrates for treatment locally and zinc concentrates for shipment to Anaconda and Great Falls, Mont. The new flotation plant for oxidized lead ore treated about 60,000 tons of siliceous silver-lead ore from the Tintic district.

The copper-smelting plant treated 156,000 tons of copper material, chiefly from Utah, California, and Idaho, and the lead plant about 232,000 tons of ore and concentrates, chiefly from Utah and Nevada.

From 1917 to 1928 the smelting plants treated 1,458,146 tons of copper material and 2,672,680 tons of lead material, from which 385,026 ounces of gold, 69,858,333 ounces of silver, 215,049,282 pounds of copper, and 963,531,515 pounds of lead were recovered, largely from Utah ores. Results for 1929 are not given separately for the two smelting plants at International, but the Anaconda Copper Mining Co., in its annual report for 1929, states that the lead plant produced from custom ores 38,163.64 ounces of gold, 6,356,611 ounces of silver, and 152,536,672 pounds of lead. The production from the copper plant was combined with the output of the copper plant of the International Smelting Co. at Miami, Ariz.

Clifton district (*Gold Hill*).—Ten lode mines in the Clifton district produced 415 tons of ore, which yielded $9,928 in gold, 1,229 ounces of silver, 40,011 pounds of copper, and 1,237 pounds of lead, valued in all at $17,703, or $42.66 in metals a ton. The entire output was first-class smelting ore, and most of it was copper ore from prospects near Gold Hill. The chief producers were the Gold Hill Copper Co., operating the Franke mine, and the Copperopolis and Monocco properties. Three cars of ore containing an average of more than 5 ounces of gold to the ton were shipped from the Rube group (Palmer property). Other producers were the Copper King, Lucy L., Rochester, and Young properties. A car of copper ore was shipped from the dump of the Western Utah Copper Co.

Columbia district.—The Benmore Mining Co. was organized in July, 1929, to operate the old Sharp and Sunday claims in Harker Canyon. No development was done at the property during the year, but a small lot of high-grade oxidized lead ore was shipped from the Sharp mine by lessees before it was acquired by the Benmore Mining Co.

Erickson district.—Three lode mines in the Erickson district produced 88 tons of ore, which yielded $24 in gold, 152 ounces of silver, 5,091 pounds of copper, 13,429 pounds of lead, and 2,879 pounds of zinc, valued in all at $2,037, or $23.15 in metals a ton. With the exception of 15 tons of lead-zinc ore of milling grade the entire output was first-class smelting ore and consisted chiefly of oxidized copper ore from the Copper Jack and Flying Dutchman group on Sheep Rock Mountain. The property is opened by an inclined shaft 235 feet deep, a tunnel 657 feet long, and 57 feet of drifts. It is reported that about 25,000 tons of low-grade copper ore has been blocked out. A test lot of lead-zinc ore from the Utah-Zinc group owned by the Union Associated Mines Co., formerly the Utah-Majestic Mines Co., was shipped to the custom flotation plant at Midvale. Development in 1929 consisted of 700 feet of tunneling.

Lakeside district.—Considerable development was done at the Monarch property by the American Smelting & Refining Co., and a car of high-grade lead ore was shipped from Delle, on the Western Pacific Railroad. The Georgia Lyn property was also worked, and two cars of first-class oxidized lead ore were shipped to the smelter at Midvale. About 1,000 feet of work was done in 1929 in the tunnels and winzes.

Ophir district.—Four lode mines in the Ophir district produced 287 tons of ore, which yielded $387 in gold, 5,998 ounces of silver, 12,659 pounds of copper, and 50,318 pounds of lead, valued in all at $8,982, or $31.30 in metals a ton. The entire output was first-class smelting ore, and most of it was oxidized lead ore from the Mono mine and oxidized copper ore and copper-lead ore from the Kearsarge Standard property. The Ophir-Mono Mines (Inc.) worked the Mono property most of the year and shipped three cars of first-class oxidized silver-lead ore by way of St. John, the nearest shipping point on the Los Angeles & Salt Lake Railroad. More than 3,000 feet of work was done in 1929 in tunneling, crosscutting, and raising. The Kearsarge Standard Mining Co. shipped several cars of first-class oxidized copper ore and copper-lead ore to the International copper and lead plants. The property is opened by an inclined shaft 1,500 feet deep and by drifts and tunnels aggregating about 2,000 feet. Development in 1929 consisted of sinking the inclined shaft 700 feet and tunneling and drifting 900 feet. Other producers in the district were the Buffalo and Lakes of Killarney properties. The Buffalo, together with other claims formerly operated by the Tintic Ophir Mines Co., was acquired by the American Smelting & Refining Co. in October, after which the mine was equipped with new machinery and more than 600 feet of development was done. Considerable work was done at the Fisk Ophir property in driving a long tunnel, which has cut the Monster fissure and opened some silver ore.

Rush Valley district (*Stockton*).—Only two mines in the Rush Valley district were active in 1929—the Honerine and Galena King groups of the Combined Metals Reduction Co. and the property of the Bluestone Lime & Quartzite Mining Co., both near Stockton. These mines produced 61,662 tons of ore, which yielded $124,806 in gold, 377,835 ounces of silver, 270,699 pounds of copper, 23,502,937 pounds of lead, and 1,045,848 pounds of zinc, valued in all at $1,923,546, or $31.19 in metals a ton. An interesting feature of the year was the large increase in the shipments of sulphide lead ore of smelting grade from the property of the Bluestone Lime & Quartzite Mining Co. The output increased from 19,064 tons of smelting ore containing 2,840 ounces of gold, 101,200 ounces of silver, and 6,046,564 pounds of lead in 1928 to 29,100 tons of ore containing 4,591 ounces of gold, 204,777 ounces of silver, and 15,931,848 pounds of lead in 1929. The property ranked eighth in Utah in 1929 in the production of lead, eleventh in gold, and fifteenth in silver. It is opened by an inclined shaft 1,200 feet deep; about 2,000 feet of drifting and crosscutting was done in 1929.

The Combined Metals Reduction Co. continued to operate the Honerine and Galena King mines, northeast of Stockton. More than 16,000 tons of first-class silver-lead ore from this group was shipped to International for smelting, and about 8,800 tons of lead-zinc ore was treated at the flotation plant of the Combined Metals Reduction Co. at Bauer. In addition, about 7,000 tons of silver-lead ore was concentrated in a jigging plant at Bauer. According to a report to the industrial commission the output consisted of 27,685 tons of first-class ore and mill ore, which contained 1,559 ounces of gold, 178,742 ounces of silver, 9,455,964 pounds of lead, and 2,614,101 pounds of zinc. The actual production of zinc was less than half that shown above, which includes the zinc content of lead ore smelted at International. The output of lead ore from the Honerine mine increased materially in 1929, but the output of lead-zinc ore was decidedly less than that in 1928. The mine, which was rejuvenated in 1925, is extensively developed. In 1929 more than 8,000 feet of work was done in drifts, raises, and winzes. In addition to being a large producer of gold and silver the company ranked tenth in Utah in 1929 in the production of lead and eleventh in the production of zinc.

The flotation plant at Bauer was operated the entire year on ore from Utah, Nevada, Idaho, and Colorado, and its capacity was increased from 200 to 700 tons of ore a day. Lead concentrates from the plant were shipped to the International smelter and the zinc product was shipped to Anaconda and Great Falls, Mont. The milling work at Bauer has been distinctly successful, and the plant has been developed into an important custom mill. New equipment installed at the plant late in 1929 consists chiefly of a Symons cone crusher, an 8-foot by 36-inch Hardinge ball mill, a 72-inch Akins classifier, and a 400-ton Denver Sub A (Fahrenwald) flotation machine.

Silver Islet district.—The Silver Glance Mining Co. worked its property 14 miles northeast of Wendover and shipped two cars of siliceous silver ore to smelters near Salt Lake City. The property is opened by a vertical shaft 60 feet deep and by about 400 feet of drifts and open cuts; development in 1929 consisted of 470 feet of work in the shaft, tunnel, and opencut.

Wild Cat Range district.—The Utah Silver Co. worked the Silver Queen group near Clive, a shipping point on the Western Pacific Railroad, and produced a car of siliceous silver ore containing a little copper. The property is chiefly interesting for its fluorspar, which was being developed by opencuts.

UINTAH COUNTY

Carbonate district.—The Dyer mine, north of Vernal, a producer of exceptionally high-grade copper ore in the past, has been idle since 1904. On account of the high price of copper the mine was worked in 1929, and a small quantity of ore containing about 30 per cent of copper was hauled by auto truck 240 miles to the smelter at Garfield.

Green River district.—A small quantity of placer gold was produced from the banks of the Green River near Vernal.

UTAH COUNTY

The value of the mine production of metals in Utah County increased from $6,892,431 in 1928 to $7,407,899 in 1929; the metal output was more valuable than that of any county in the State except Salt Lake County. The decided increase in the output of gold was due chiefly to the increase in the production of siliceous gold ore from the Eureka Standard mine, and the notable increase in the output of lead was due largely to the increase in the production of oxidized lead ore from the North Lily mine. The output of metals from the Tintic Standard property in 1929 was slightly less than that in 1928.

Mine production of gold, silver, copper, lead, and zinc in American Fork district, Utah, 1928 and 1929, and total, 1870–1929, in terms of recovered metals

Year	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1928	3	4,676	$62,176	19,381	116,089	139,016		$98,294
1929	3	5,737	34,270	18,458	70,563	383,032		80,658
Total, 1870–1929		99,315	549,627	2,048,636	1,021,297	31,892,776	313,926	4,674,499

American Fork district.—Three lode mines in the American Fork district produced 5,737 tons of ore, which yielded $34,270 in gold, 18,458 ounces of silver, 70,563 pounds of copper, and 383,032 pounds of lead, valued in all at $80,658, or $14.06 in metals a ton. The output consisted of 537 tons of first-class smelting ore and 5,200 tons of milling ore. The Live Yankee mine was operated until November 17 by the Yankee Mines Co. In November the property was purchased by the American Smelting & Refining Co., under whose management it was operated the remainder of the year. Most of the output was sulphide copper ore treated in an old 50-ton concentration plant equipped with jigs and tables. The ore consists mainly of pyrite, chalcopyrite, and chalcocite, and is valuable chiefly for its gold, which averages about 1 ounce to the ton of first-class smelting ore.

The mine is opened by a tunnel 1,200 feet long, and development in 1929 consisted of 100 feet of tunneling and 60 feet of sinking. According to a report made to the industrial commission 1,148 tons of first-class smelting ore and concentrates were shipped, containing 1,379 ounces of gold, 6,729 ounces of silver, and 77,424 pounds of copper, valued in all at $37,370. This output represents a decided decrease from that in 1928, when 2,454 tons of first-class smelting ore and concentrates were shipped, containing 3,067 ounces of gold, 16,393 ounces of silver, 145,196 pounds of copper, and 11,289 pounds of lead. The property has been a large producer of gold since 1925. The Pacific Gold Mining & Milling Co. reconstructed the mill on its property and added flotation equipment; more than 2,000 tons of sulphide lead ore was treated in the 35-ton flotation plant, and silver-lead concentrates and two cars of first-class ore were shipped to Murray for smelting. A test lot of first-class oxidized lead ore was marketed from the Miller property.

Tintic district.—The following mines, which are in Utah County in the eastern part of the Tintic district, are mentioned in the general review under Juab County: Tintic Standard, North Lily, Eureka Standard, Eureka Lilly, Mountain View (May Day), Iron King, Colorado Consolidated, Yankee, Utah Consolidated, Eureka Bullion, Tintic Bullion, and Sioux.

WASHINGTON COUNTY

Bull Valley (Gold Strike) district.—The Hamburg group, 30 miles south of Modena, owned by the Bull Valley Gold Mines Co., was operated by a lessee who produced a small quantity of high-grade gold ore which was treated by amalgamation in a hand mortar. The resulting gold bullion, valued at $820, was shipped to the assay office at Salt Lake City.

Harrisburg district.—Work was continued at the Silver Reef property near Leeds under the direction of the American Smelting & Refining Co., but no ore was treated or marketed in 1929. The property is opened by a vertical shaft 540 feet deep; development in 1929 consisted of 80 feet of sinking, 2,355 feet of drifting, and 399 feet of raising. Although the district produced considerable silver in the past, chiefly from 1875 to 1890, intensive development in 1928 and 1929 failed to open commercial ore bodies.

Tutsagubet district.—The Dixie mine, near St. George, owned by the Utah Southern Mining Co., was operated by lessees who shipped several cars of high-grade oxidized copper ore to the International smelter. The ore, which averaged about 30 per cent of copper, was hauled 70 miles to Cedar City, the nearest shipping point on the Los Angeles & Salt Lake Railroad.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA[1]

(MINE REPORT)

By V. C. Heikes[2]

SUMMARY

In 1929 the total value of the mine production of gold, silver, copper, lead, and zinc in Nevada was $33,030,237, or 6 per cent more than in 1928, but the number of producers reporting (338) was 21 less. The quantity and value of both gold and silver decreased in 1929; the quantity of copper decreased, but the value increased; and the quantity and value of both lead and zinc showed a substantial increase over 1928. White Pine County led in the value of the metals recorded and yielded over 74 per cent of the total value of the metals produced in the State in 1929, due to the large output of copper in the county. Three other counties each produced metals worth more than $1,000,000: Lincoln County, with the largest output of lead and zinc; Nye County, with its chief value in silver; and Elko County, in fourth place, with its chief value in gold. Esmeralda, Lyon, and Lander Counties, each with an output valued at between $500,000 and $900,000, followed in order.

The total value of the mine production of gold, silver, copper, lead, and zinc in Nevada for 1904 to 1929, inclusive, as recorded in Mineral Resources, was $717,863,263. Details of production are as follows: Ore, old tailings, etc., 101,971,403 short tons; gold, $209,211,477; silver, 245,996,850 fine ounces ($167,588,011); copper, 1,738,583,566 pounds ($295,424,786); lead, 374,402,446 pounds ($23,943,747); and zinc, 255,973,075 pounds ($21,695,242).

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1920 to 1922 is New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

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[1] Work on manuscript completed February, 1931.

[2] Helen M. Gaylord, of the Bureau of Mines, prepared the statistics for this report.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1920	$1.09	$0.184	$0.080	$0.081	1925	$0.694	$0.142	$0.087	$0.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064
1923	.82	.147	.070	.068	1928	.585	.144	.058	.061
1924	.67	.131	.080	.065	1929	.533	.176	.063	.066

Mine production of gold, silver, copper, lead, and zinc in Nevada, 1920–1929, in terms of recovered metals

Year	Mines producing		Ore, old tailings, etc. (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1920	434	39	3, 480, 620	172, 540. 46	$3, 566, 728	7, 745, 093	$8, 442, 151
1921	370	64	1, 096, 138	160, 254. 62	3, 312, 757	7, 083, 782	7, 083, 782
1922	345	42	1, 565, 276	159, 510. 95	3, 297, 384	8, 619, 587	8, 619, 587
1923	354	35	4, 354, 937	204, 292. 89	4, 223, 109	10, 614, 564	8, 703, 942
1924	348	36	4, 699, 333	217, 962. 56	4, 505, 686	9, 411, 379	6, 305, 624
1925	399	25	4, 927, 139	187, 104. 72	3, 867, 798	7, 096, 618	4, 925, 053
1926	377	28	5, 884, 568	175, 381. 68	3, 625, 461	6, 518, 983	4, 067, 845
1927	379	30	5, 531, 152	150, 346. 16	3, 107, 931	5, 397, 179	3, 060, 200
1928	330	29	7, 057, 433	175, 157. 79	3, 620, 833	5, 481, 574	3, 206, 721
1929	323	15	7, 355, 500	163, 711. 22	3, 384, 211	4, 923, 526	2, 624, 239

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1920	50, 559, 763	$9, 302, 996	21, 263, 700	$1, 701, 096	10, 698, 040	$866, 541	$23, 879, 512
1921	10, 961, 491	1, 414, 032	7, 188, 768	323, 495	69, 397	3, 470	12, 137, 536
1922	23, 133, 091	3, 122, 967	9, 389, 182	516, 405	2, 618, 710	149, 266	15, 705, 609
1923	67, 204, 282	9, 879, 029	18, 156, 337	1, 270, 944	14, 166, 550	963, 325	25, 040, 349
1924	73, 805, 323	9, 668, 497	20, 060, 041	1, 604, 803	11, 002, 910	715, 189	22, 799, 799
1925	79, 300, 224	11, 260, 632	24, 476, 452	2, 129, 451	14, 821, 293	1, 126, 418	23, 309, 352
1926	101, 827, 937	14, 255, 911	22, 367, 965	1, 789, 437	10, 817, 833	811, 337	24, 549, 991
1927	120, 259, 276	15, 753, 965	15, 784, 818	994, 444	6, 344, 523	406, 049	23, 322, 589
1928	158, 876, 883	22, 878, 271	15, 747, 444	913, 352	6, 796, 713	414, 599	31, 033, 776
1929	140, 138, 809	24, 664, 430	19, 692, 568	1, 240, 632	16, 920, 083	1, 116, 725	33, 030, 237

Gold and silver produced at placer mines in Nevada, 1920–1929

Year	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value
1920	7, 383. 91	$152, 639	3, 296	$3, 593
1921	17, 566. 99	363, 142	7, 956	7, 956
1922	11, 602. 36	239, 842	4, 710	4, 710
1923	3, 941. 83	81, 485	1, 783	1, 462
1924	1, 323. 97	27, 369	546	366
1925	2, 536. 54	52, 435	1, 285	892
1926	2, 866. 17	59, 249	1, 494	932
1927	1, 809. 22	37, 400	740	419
1928	1, 851. 12	38, 266	839	491
1929	2, 117. 00	43, 762	1, 025	546

GOLD

The mine production of gold in Nevada decreased from $3,620,833 in 1928 to $3,384,211 in 1929. In 1929, as in 1928 and 1927, the Nevada Consolidated Copper Co. was by far the largest producer of gold in Nevada. Ore was treated by amalgamation and ore and old tailings by cyanidation in 12 counties in 1929. By these two methods $1,650,409 in gold was recovered from 229,923 tons of ore and 282,820 tons of old tailings. Most of the placer gold in 1929 was obtained by hydraulicking and sluicing in the Round Mountain and Manhattan districts, Nye County, and by drifting and sluicing in the Battle Mountain district, Lander County. Amalgamation and cyanidation mills yielded nearly 49 per cent of the total gold, concentrates slightly more than 40 per cent (practically all in flotation concentrates), and crude smelting ore more than 9 per cent.

Eight properties supplied nearly 78 per cent of the total gold from Nevada in 1929, each producing more than 5,000 ounces. The Nevada Consolidated property at Ely was first, followed by the Elkoro at Jarbidge, the Goldfield Consolidated tailings dump (Bradshaw (Inc.)) at Goldfield, the Consolidated Coppermines at Kimberly, the Tonopah Mining Co. at Tonopah, the Tonopah Extension at Tonopah, the Gold Circle Consolidated at Midas, and the White Caps at Manhattan.

SILVER

In 1929 the mine production of silver in Nevada was 4,923,526 fine ounces, a decrease of 558,048 ounces from 1928. In Nye County 1,358,561 ounces of silver was contained in bullion recovered at amalgamation and cyanidation mills; most of this silver—1,357,397 ounces—was recovered by cyanidation. Concentrates recovered from ores and old tailings produced in Nevada yielded 1,676,793 ounces of silver; 1,638,813 ounces was contained in flotation concentrates. Lead concentrates yielded 1,117,663 ounces of silver, an average recovery of 89.72 ounces a ton, compared with 1,557,274 ounces, an average of 186.95 ounces, in 1928.

Eight properties, each producing more than 200,000 ounces, yielded 73 per cent of the total silver from Nevada in 1929. These properties, in order of output, were the Tonopah Mining and Tonopah Extension at Tonopah, the Bristol Silver at Pioche, the Tonopah Belmont at Tonopah, the Consolidated Cortez at Cortez, the Treadwell Yukon at Tybo, the Combined Metals Lease at Pioche, and the Betty O'Neal near Battle Mountain.

COPPER

In 1929 the mine production of copper in Nevada was 140,138,809 pounds, a decrease of 12 per cent from 1928. The total value increased $1,786,159, or nearly 8 per cent, over 1928. Concentrates yielded nearly 92 per cent of the total copper, and crude ore shipped to smelters yielded 8 per cent. Flotation concentrates yielded 128,874,746 pounds and table concentrates 24,430 pounds. The Nevada Consolidated Copper Co., operating its mine, mill, and smelter at Ely and McGill, was the largest producer of copper in the State, although the general policy to curtail production was followed. This property, with two others, the Consolidated Coppermines and the Mason Valley Mines, yielded more than 95 per cent of the total copper from Nevada in 1929. The next largest producers were the Bristol Silver mine near Pioche and the Copper Canyon property near Battle Mountain.

LEAD

The mine production of lead in Nevada in 1929 was 19,692,568 pounds, an increase (3,945,124 pounds) over the output in 1928. Concentrates recovered from milling ore and old tailings yielded 11,229,255 pounds, of which 10,493,012 pounds was recovered by flotation and 736,243 pounds by table concentration. The total crude ore of shipping grade yielded 8,417,222 pounds of lead, compared with 10,284,619 pounds in 1928.

Nine mines yielded over 90 per cent of the total lead from Nevada in 1929. The Combined Metals Lease in Lincoln County was the largest producer, followed by Bristol Silver in Lincoln County, Treadwell Yukon in Nye County, Richmond-Eureka in Eureka County, Yellow Pine in Clark County, Panther Mines in Elko County, Nevada Lead & Zinc in Elko County, Consolidated Cortez in Eureka County, and Anchor mine in Clark County.

ZINC

In 1929 the mine production of zinc in Nevada was 16,920,083 pounds, nearly 2½ times that in 1928. The Pioche district in Lincoln County produced nearly 77 per cent of the total zinc output of the State and was followed by the Tybo district in Nye County, and the Yellow Pine district in Clark County; the Combined Metals Lease at Pioche in Lincoln County, the Treadwell Yukon mine in Nye County, and several properties in the Yellow Pine district in Clark County yielded practically all the zinc. Small quantities of zinc came from Elko, Eureka, and Mineral Counties. Sulphide zinc-lead ore from Pioche was treated by flotation in the plant of the Combined Metals Reduction Co. at Bauer, Utah; the resulting lead concentrates were shipped to International, Utah, and the zinc product was shipped to the electrolytic zinc plant near Great Falls, Mont. Zinc concentrates produced by the Treadwell Yukon Co. were shipped to an electrolytic zinc plant at Silver King, Idaho.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1929, by counties, in terms of recovered metals

County	Gold					Silver (lode and placer)	
	Lode		Placer		Total value	Fine ounces	Value
	Fine ounces	Value	Fine ounces	Value			
Churchill	13.96	$289			$289	3,147	$1,677
Clark	1,566.29	32,378			32,378	21,022	11,205
Douglas	11.95	247			247	476	254
Elko	34,700.23	717,317			717,317	331,094	176,473
Esmeralda	22,201.94	458,955			458,955	774,131	412,612
Eureka	2,334.61	48,261	62.75	$1,297	49,558	521,610	278,018
Humboldt	1,297.69	26,826			26,826	40,194	21,423
Lander	1,129.14	23,341	213.14	4,406	27,747	234,713	125,102
Lincoln	1,830.32	37,836			37,836	852,241	454,244
Lyon	1,671.61	34,555			34,555	59,308	31,611
Mineral	2,009.22	41,534			41,534	37,167	19,810
Nye	22,513.36	465,392	1,674.01	34,605	499,997	1,713,229	913,151
Ormsby	7.68	159			159	67	36
Pershing	516.88	10,685	149.40	3,088	13,773	55,944	29,818
Storey	5,315.40	109,879			109,879	32,399	17,269
Washoe	111.25	2,300			2,300	1,917	1,022
White Pine	64,362.69	1,330,495	17.70	366	1,330,861	244,867	130,514
	161,594.22	3,340,449	2,117.00	43,762	3,384,211	4,923,526	2,624,239
Total, 1928	173,306.67	3,582,567	1,851.12	38,266	3,620,833	5,481,574	3,206,721

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1929, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Churchill	498	$88	140, 315	$8, 840			$10, 894
Clark	47, 000	8, 272	1, 080, 457	68, 069	1, 236, 702	$81, 622	201, 546
Douglas	9, 787	1, 723	3, 448	217			2, 441
Elko	727, 768	128, 087	1, 604, 176	101, 063	64, 124	4, 232	1, 127, 172
Esmeralda	20, 962	3, 689	58, 342	3, 676			878, 932
Eureka	41, 917	7, 377	1, 191, 478	75, 063	17, 270	1, 140	411, 156
Humboldt	23, 539	4, 143	7, 076	446			52, 838
Lander	2, 457, 290	432, 483	135, 891	8, 561			593, 893
Lincoln	2, 652, 115	466. 772	10, 894, 251	686, 338	12, 995, 496	857, 703	2, 502, 893
Lyon	3, 283, 349	577, 869	6, 197	390			644, 425
Mineral	56, 536	9, 950	40, 036	2, 522	1, 113	73	73, 889
Nye	3, 835	675	3, 982, 904	250, 923	2, 605, 378	171. 955	1, 836, 701
Ormsby	1, 634	288					483
Pershing	27, 975	4, 924	36, 102	2, 274			50, 789
Storey	2, 611	460					127, 608
Washoe	7, 724	1, 359	12, 361	779			5, 460
White Pine	130, 774, 269	23, 016, 271	499, 534	31, 471			24, 509, 117
	140, 138, 809	24, 664, 430	19, 692, 568	1, 240, 632	16, 920, 083	1, 116, 725	33, 030, 237
Total, 1928	158, 876, 883	22, 878, 271	15, 747, 444	913, 352	6, 796, 713	414, 599	31, 033, 776

Ore, old tailings, etc., sold or treated, lode mines producing, and average value of ore, etc., in gold and silver in Nevada, 1928 and 1929, by counties

County	Ore, old tailings, etc. (short tons)		Lode mines producing		Average value per ton in gold and silver	
	1928	1929	1928	1929	1928	1929
Churchill	625	976	4	3	$8. 96	$2. 01
Clark	13, 059	7, 274	20	23	2. 43	5. 99
Douglas	250	60	1	3	. 04	8. 35
Elko	85, 990	78, 016	30	37	10. 11	11. 46
Esmeralda	301, 307	351, 930	36	27	3. 28	2. 48
Eureka	57, 173	49, 311	7	9	9. 33	6. 62
Humboldt	606	644	9	12	55. 76	74. 92
Lander	37, 514	27, 159	21	25	9. 84	5. 47
Lincoln	68, 311	121, 010	15	8	6. 09	4. 07
Lyon	565, 508	182, 311	17	20	. 15	. 36
Mineral	2, 564	1, 931	36	33	30. 30	31. 77
Nye	83, 875	131, 074	54	47	16. 53	10. 51
Ormsby	20	1, 219	1	2	4. 20	. 16
Pershing	30, 847	4, 799	12	17	6. 16	8. 44
Storey	76, 441	11, 244	19	13	2. 65	11. 31
Washoe	242	322	14	14	24. 38	10. 32
White Pine	5, 733, 101	6, 386, 220	34	30	. 28	. 23
	7, 057, 433	7, 355, 500	330	323	. 96	. 81

Gold and silver produced at placer mines in Nevada in 1929, by counties

County	Mines		Gold	Silver (fine ounces)	Total value
	Drift	Hydraulic and sluicing			
Eureka		1	$1, 297	5	$1, 300
Lander	3		4, 406	29	4, 421
Nye	2	6	34, 605	972	35, 123
Pershing		2	3, 088	15	3, 096
White Pine	1		366	4	368
	6	9	43, 762	1, 025	44, 308
Total, 1928	13	16	38, 266	839	38, 757

MINING INDUSTRY

Increases in the quantity of lead and zinc, together with increased prices for copper, lead, and zinc, brought the total value of metals produced in Nevada in 1929 to $33,030,237, an increase of $1,996,461 over the value in 1928. The quantity of ore and old tailings sold or treated in Nevada in 1929 was 7,355,500 tons, compared with 7,057,433 tons in 1928.

Several gold mines in Nye and Pershing Counties have been under development during the past two years preparatory to producing in 1930. The most important construction work was that started on the new cyanidation mill of the Seven Troughs Gold Mines Co. in Pershing County; plans were also made for a new reduction plant near Round Mountain for the Gold Hill Development Co. The Nevada Porphyry Gold Mines Co. took over the property of the Round Mountain Mines Co. and planned to increase the capacity of the Round Mountain amalgamation mill to treat both ore from the lode mine and surface material from the placers. Manhattan Gulch was under examination by engineers with a view to dredging the gravel deposits. Rich gold ore was developed by the Gold Metals (Inc.) in the Sullivan lode mine, in the canyon a mile below Manhattan. At Nyala testing of ores recently developed gave promise of adding to the gold output from that section in 1930. At Silver Peak lessees on the Mary mine and at the Valcalda property reported having improved the recovery of gold and silver by adding flotation equipment. Offsetting these developments the Gold Circle Consolidated, an important producer of gold, closed its cyanide mill in August pending further mine development.

With the declining price of silver the Tonopah region was affected most seriously by the changes found necessary in operation of the mines. The Tonopah Belmont and Tonopah Mining companies ceased mining on company account, giving over the operations of part if not all of their mines to lessees. The West End Consolidated suspended activities altogether. The Tonopah Extension was sold by its receiver and, beginning the first of April, operated as the Tonopah Extension Mines (Inc.). Changes were also made at other mines in Nevada. The Betty O'Neal Mines Co. in Lander County leased the upper levels of the mine to former employees, who mined some ore which was treated in the flotation mill on a custom basis. The Rochester Silver Corporation closed its mine and cyanide mill in Pershing County in February; the mill was dismantled soon afterwards.

Mine operations slackened in the region served by the Mason Valley copper smelter at Thompson; the smelter discontinued the receipt of ores in March, in accordance with the announcement by the Mason Valley Mines Co. in December, 1928. In June the smelter, flotation mill, and mine were sold to the Eastern Iron & Metal Co. Dismantling of the flotation plant and smelter was begun by the new owner; the mine was leased to operators who shipped some copper ore to smelters in Utah.

Mines at Pioche in Lincoln County and at Tybo in Nye County were benefited by the treatment of lead-zinc ores by flotation. At Pioche nearly three times as much lead and more than twice as much zinc was produced as in 1928. In the adjoining Jack Rabbit district more ore of smelting grade was produced, and the quantities of silver, copper, and lead exceeded the output in any previous year. In the

Yellow Pine district, Clark County, the Yellow Pine Mining Co., the largest producer of zinc in many former years, was reconstructing a mill to use flotation on oxidized lead-zinc ores. Construction of the mill was started in August and nearly completed at the close of the year.

Early in 1929 the Nevada State Legislature appropriated $10,000 to be expended on geologic and topographic work in cooperation with the United States Geological Survey. The Nevada Mine Operators Association recommended that one of the projects undertaken under this fund be a geologic resurvey of the Tonopah mining district in Nye and Esmeralda Counties.

ORE CLASSIFICATION

Ore, old tailings, etc., sold or treated in Nevada, 1920–1929, with content in terms of recovered metals

DRY AND SILICEOUS ORE

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1920	799, 207	136, 058. 51	6, 939, 579	168, 534	5, 789, 125	----------
1921	667, 560	133, 294. 94	6, 539, 514	229, 989	1, 574, 307	----------
1922	871, 883	140, 506. 36	7, 809, 857	146, 038	922, 499	----------
1923	1, 371, 970	167, 194. 50	9, 084, 056	776, 393	4, 632, 914	----------
1924	1, 066, 479	181, 627. 55	8, 002, 859	303, 183	2, 438, 701	----------
1925	844, 948	140, 878. 25	5, 261, 402	51, 838	1, 016, 134	----------
1926	806, 518	126, 615. 10	4, 509, 178	51, 778	867, 426	----------
1927	515, 825	94, 707. 50	3, 419, 940	41, 028	179, 711	----------
1928	641, 004	100, 303. 36	2, 977, 433	33, 112	44, 448	----------
1929	537, 664	90, 655. 65	2, 828, 537	47, 539	178, 119	----------
COPPER ORE						
1920	2, 616, 237	22, 924. 19	82, 977	49, 858, 120	4, 871	----------
1921	401, 153	4, 747. 21	19, 323	10, 318, 851	21	----------
1922	629, 408	4, 400. 63	17, 127	[1] 22, 640, 042	424	----------
1923	2, 833, 908	29, 551. 13	84, 568	66, 089, 635	2, 697	----------
1924	3, 505, 301	32, 314. 93	106, 614	[1] 73, 325, 336	----------	----------
1925	3, 923, 158	35, 515. 84	125, 477	[1] 78, 795, 059	----------	----------
1926	4, 888, 681	36, 408. 95	142, 316	[1] 100, 870, 898	1, 417	----------
1927	4, 885, 052	46, 883. 96	183, 525	[1] 118, 667, 453	18	----------
1928	6, 244, 047	68, 530. 96	258, 519	156, 746, 489	1, 000	----------
1929	6, 572, 404	65, 287. 67	255, 254	137, 666, 757	9, 982	----------
LEAD ORE						
1920	40, 544	3, 237. 01	520, 971	158, 364	11, 111, 973	----------
1921	25, 597	4, 614. 98	496, 826	384, 739	5, 415, 434	----------
1922	39, 462	2, 979. 85	698, 590	331, 168	6, 266, 647	----------
1923	84, 764	2, 571. 61	1, 238, 842	300, 625	8, 352, 022	----------
1924	81, 202	1, 995. 82	1, 093, 429	154, 363	10, 314, 895	----------
1925	94, 769	6, 882. 73	1, 361, 753	351, 494	16, 131, 583	----------
1926	111, 265	8, 538. 16	1, 395, 285	252, 687	14, 254, 647	----------
1927	75, 924	6, 214. 20	1, 405, 418	181, 972	10, 160, 264	----------
1928	101, 416	3, 143. 86	1, 593, 463	183, 616	7, 764, 803	----------
1929	74, 839	3, 212. 86	671, 478	84, 771	4, 274, 324	----------
COPPER-LEAD ORE						
1920	6, 269	2, 936. 41	114, 358	374, 745	1, 340, 286	----------
1921	1, 689	30. 50	20, 163	27, 912	154, 288	----------
1922	102	1. 90	2, 153	11, 283	39, 869	----------
1923	330	708. 16	13, 089	21, 769	60, 558	----------
1924	3	. 05	1, 786	489	893	----------
1925	125	4. 87	3, 259	11, 426	43, 851	----------
1926	10, 151	203. 51	147, 470	594, 800	1, 285, 217	----------
1927	25, 304	416. 89	280, 713	1, 323, 304	2, 564, 602	----------
1928	40, 329	850. 85	485, 946	1, 835, 129	5, 120, 612	----------
1929	56, 644	727. 23	491, 175	2, 322, 866	4, 931, 359	----------

[1] Includes copper saved from precipitates recovered from mine water

Ore, old tailings, etc., sold or treated in Nevada, 1920–1929, with content in terms of recovered metals—Continued

ZINC ORE AND LEAD-ZINC ORE

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1920	18,363	0.43	83,912		3,017,445	10,698,040
1921	139				44,718	69,397
1922	24,421	19.85	87,150	4,560	2,159,743	2,618,710
1923	63,965	325.66	192,226	15,860	5,108,146	14,166,550
1924	46,348	700.24	206,145	21,952	7,305,552	11,002,910
1925	64,139	1,286.49	343,442	90,407	7,284,884	14,821,293
1926	67,953	749.79	323,240	57,774	5,959,258	10,817,833
1927	29,047	314.39	106,843	45,524	2,880,223	6,344,523
1928	30,637	477.64	165,374	78,537	2,816,581	6,796,713
1929	113,949	1,710.81	676,057	16,876	10,298,784	16,920,083

Ore, old tailings, etc., sold or treated in Nevada in 1929, with content in terms of recovered metals

Source	Mines producing	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	118	[1] 384,381	65,742.36	289,345	12,056	5,816	
Dry gold and silver ore	10	[2] 3,953	1,725.61	63,763	12,655	17,916	
Dry silver ore	41	[3] 149,330	23,187.68	2,475,429	22,828	154,387	
Copper ore	61	6,572,404	65,287.67	255,254	137,666,757	9,982	
Lead ore	76	[4] 74,839	3,212.86	671,478	84,771	4,274,324	
Zinc ore	2	177		378	70	12,536	118,613
Copper-lead ore	6	56,644	727.23	491,175	2,322,866	4,931,359	
Lead-zinc ore	9	113,772	1,710.81	675,679	16,806	10,286,248	16,801,470
Total, lode mines	[5] 323	7,355,500	161,594.22	4,922,501	140,138,809	19,692,568	16,920,083
Total, placers	15		2,117.00	1,025			
	338	7,355,500	163,711.22	4,923,526	140,138,809	19,692,568	16,920,083
Total, 1928	359	7,057,433	175,157.79	5,481,574	158,876,883	15,747,444	6,796,713

[1] Includes 281,220 tons of old tailings cyanided and 4 tons of sweepings sold to a smelter.

[2] Includes 2,550 tons of old tailings concentrated.

[3] Includes 1,600 tons of old tailings cyanided and 130 tons of old tailings and 22 tons of clean-up material sold to a smelter.

[4] Includes 756 tons of old tailings and 8 tons of slag sold to a smelter.

[5] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

Value of metals from ore, old tailings, etc., sold or treated in Nevada in 1929, by classes of ore

Class	Ore, old tailings, etc. (short tons)	Gold	Silver	Copper	Lead	Zinc	Total value
Dry gold ore	384,381	$1,359,015	$154,221	$2,122	$366		$1,515,724
Dry gold and silver ore	3,953	35,671	33,986	2,227	1,129		73,013
Dry silver ore	149,330	479,332	1,319,404	4,018	9,726		1,812,480
Copper ore	6,572,404	1,349,616	136,050	24,229,349	629		25,715,644
Lead ore	74,839	66,416	357,898	14,920	269,282		708,516
Zinc ore	177		201	12	790	$7,828	8,831
Copper-lead ore	56,644	15,033	261,796	408,824	310,676		996,329
Lead-zinc ore	113,772	35,366	360,137	2,958	648,034	1,108,897	2,155,392
	7,355,500	3,340,449	2,623,693	24,664,430	1,240,632	1,116,725	32,985,929
Total, 1928	7,057,433	3,582,567	3,206,230	22,878,271	913,352	414,599	31,033,776

Ore, old tailings, etc., sold or treated in Nevada in 1929, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Clark	1,766	1,211.49	2,576	654	3,277	----------
Elko	65,128	33,954.48	253,107	----------	----------	----------
Esmeralda	[1] 282,621	14,656.21	7,949	8,949	539	----------
Humboldt	118	64.57	21	----------	----------	----------
Lander	839	815.88	6,234	534	2,000	----------
Lyon	1,968	686.25	574	----------	----------	----------
Mineral	927	1,321.98	3,354	1,003	----------	----------
Nye	[2] 18,418	7,805.95	2,809	----------	----------	----------
Ormsby	[3] 1,200	7.68	49	----------	----------	----------
Pershing	118	137.89	409	----------	----------	----------
Storey	[4] 10,372	4,723.53	12,075	----------	----------	----------
Washoe	213	99.37	60	----------	----------	----------
White Pine	[4] 693	257.08	128	916	----------	----------
	384,381	65,742.36	289,345	12,056	5,816	----------
Total, 1928	419,043	73,223.74	405,646	2,087	4,420	----------
DRY GOLD AND SILVER ORE						
Lyon	[5] 2,550	506.45	26,458	11,023	3,582	----------
Mineral	348	545.03	15,024	1,347	14,334	----------
Nye	144	225.26	6,217	----------	----------	----------
Storey	826	417.89	14,284	285	----------	----------
White Pine	85	30.98	1,780	----------	----------	----------
	3,953	1,725.61	63,763	12,655	17,916	----------
Total, 1928	75,297	2,911.02	117,733	25,776	32,706	----------
DRY SILVER ORE						
Clark	27	6.05	1,650	----------	1,049	----------
Douglas	2	2.75	344	----------	158	----------
Elko	24	9.54	6,398	----------	----------	----------
Esmeralda	69,123	7,536.21	762,677	306	----------	----------
Eureka	[6] 313	86.51	9,832	----------	695	----------
Humboldt	246	1,230.26	38,721	167	110	----------
Lander	10,982	12.01	201,022	13,060	75,079	----------
Lincoln	949	26.32	2,629	8,662	77,296	----------
Lyon	193	71.83	2,493	----------	----------	----------
Mineral	12	1.84	799	150	----------	----------
Nye	[7] 58,424	13,790.31	1,370,304	483	----------	----------
Pershing	[8] 4,435	368.12	52,677	----------	----------	----------
White Pine	[9] 4,600	45.93	25,883	----------	----------	----------
	149,330	23,187.68	2,475,429	22,828	154,387	----------
Total, 1928	146,664	24,168.60	2,454,054	5,249	7,322	----------
COPPER ORE						
Clark	342	7.69	189	37,693	----------	----------
Douglas	53	4.75	28	9,787	----------	----------
Elko	6,625	725.05	11,127	670,339	6,982	----------
Esmeralda	98	6.41	358	10,646	----------	----------
Eureka	29	----------	1,062	4,694	----------	----------
Humboldt	237	2.26	120	22,747	----------	----------
Lander	13,715	259.37	11,682	2,441,185	3,000	----------
Lincoln	1,883	----------	16,535	332,809	----------	----------
Lyon	170,599	165.00	2,915	3,272,326	----------	----------
Mineral	490	11.08	1,023	52,991	----------	----------
Nye	20	----------	67	2,369	----------	----------
Ormsby	19	----------	18	1,634	----------	----------
Pershing	140	.14	176	27,641	----------	----------
Storey	46	173.98	6,040	2,326	----------	----------
Washoe	80	10.62	1,580	7,724	----------	----------
White Pine	6,378,028	63,921.32	202,334	130,769,846	----------	----------
	6,572,404	65,287.67	255,254	137,666,757	9,982	----------
Total, 1928	6,244,047	68,530.96	258,519	156,746,489	1,000	----------

[1] Includes 279,000 tons of old tailings cyanided and 4 tons of sweepings sold to a smelter.
[2] Includes 20 tons of old tailings cyanided.
[3] Old tailings cyanided.
[4] Includes 500 tons of old tailings cyanided.
[5] Old tailings concentrated.
[6] Includes 50 tons of old tailings sold to a smelter.
[7] Includes 1 ton of clean-up material sold to a smelter.
[8] Includes 80 tons of old tailings and 21 tons of clean-up material sold to a smelter
[9] Includes 1,600 tons of old tailings cyanided.

Ore, old tailings, etc., sold or treated in Nevada in 1929, by counties, with content in terms of recovered metals—Continued

LEAD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	976	13.96	3,147	498	140,315	------------
Clark	2,737	338.53	13,019	4,488	614,964	------------
Douglas	5	4.45	104	------------	3,290	------------
Elko	5,506	6.53	55,353	34,286	1,484,813	------------
Esmeralda	83	1.83	2,032	691	55,887	------------
Eureka	48,721	2,189.65	501,905	36,909	1,176,397	------------
Humboldt	43	.60	1,332	625	6,966	------------
Lander	1,623	41.88	15,746	2,511	55,812	------------
Lincoln	[10] 5,074	125.27	17,748	2,075	161,579	------------
Lyon	7,001	242.08	26,868	------------	2,615	------------
Mineral	149	129.15	16,838	1,045	24,924	------------
Nye	3	.66	269	------------	192	------------
Pershing	106	10.73	2,667	334	36,102	------------
Washoe	29	1.26	277	------------	12,361	------------
White Pine	[11] 2,783	106.28	14,173	1,309	498,107	------------
	74,839	3,212.86	671,478	84,771	4,274,324	------------
Total, 1928	101,416	3,143.86	1,593,463	183,616	7,764,803	------------

ZINC ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Clark	177	------------	378	70	12,536	118,613
	177	------------	378	70	12,536	118,613
Total, 1928	34	------------	------------	------------	943	19,394

COPPER-LEAD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Elko	311	1.79	3,008	13,505	66,067	------------
Esmeralda	5	1.28	1,115	370	1,916	------------
Lincoln	56,297	723.06	486,487	2,306,793	4,861,949	------------
White Pine	31	1.10	565	2,198	1,427	------------
	56,644	727.23	491,175	2,322,866	4,931,359	------------
Total, 1928	40,329	850.85	485,946	1,835,129	5,120,612	------------

LEAD-ZINC ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Clark	2,225	2.53	3,210	4,095	448,631	1,118,089
Elko	422	2.84	2,101	9,638	46,314	64,124
Eureka	248	58.45	8,806	314	14,386	17,270
Lincoln	56,807	955.67	328,842	1,776	5,793,427	12,995,496
Mineral	5	.14	129	------------	778	1,113
Nye	54,065	691.18	332,591	983	3,982,712	2,605,378
	113,772	1,710.81	675,679	16,806	10,286,248	16,801,470
Total, 1928	30,603	477.64	165,374	78,537	2,815,638	6,777,319

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[10] Includes 756 tons of old tailings sold to a smelter.
[11] Includes 8 tons of slag sold to a smelter.

Zinc ore, lead-zinc ore, and zinc concentrates (as marketed from Nevada mines and mills) sold to smelters in 1929

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore or concentrates	Recovered zinc
		Short tons	*Pounds*	*Per cent*	*Pounds*
Oxidized zinc ore	Clark	177	144,417	40.80	118,613
Oxidized lead-zinc ore	do	1,784	1,206,016	33.80	964,812
Zinc concentrates	Clark, Elko, Eureka, Lincoln, Mineral, and Nye.	20,705	18,152,339	43.84	15,836,658
		22,666	19,502,772	43.02	16,920,083
Total, 1928		8,977	7,934,459	44.19	6,796,713

METALLURGIC INDUSTRY

Producers who had been shipping siliceous ores of gold, silver, and copper from various parts of Nevada to the Mason Valley smelter at Thompson during the last few years found this outlet closed in March; thereafter they shipped the ores that were sufficiently rich in metals to smelters in Utah. At McGill the Nevada Consolidated smelter and mill operated at capacity, treating its own mine output and some custom ore from adjoining mines. Lead ores for direct smelting went to smelters in Utah and California; most of the zinc-lead ores, largely sulphide but some oxidized, were concentrated by flotation in Nevada and Utah mills. Zinc concentrates from these mills were shipped to Silver King, Idaho, and Great Falls, Mont., for electrolytic refining. In 1929 zinc-lead pigment plants in Eastern States purchased most of the oxidized ores produced in the Yellow Pine district.

Sixty-one milling plants of various kinds treated ore and old tailings in 1929. Of these, 21 used the amalgamation process, 5 amalgamation and concentration, 20 concentration (10 used flotation, 2 tables and flotation, 2 jigs and tables, and 6 tables only), 13 cyanidation, and 2 amalgamation, concentration, and cyanidation. Many of the plants operated for a short period only.

About 800 pounds of quicksilver was purchased for amalgamation plants, and 848,273 pounds of cyanide was used in cyanidation mills. Of the cyanide reagent used 475,995 pounds was reported as cyanamid.

Mine production of metals in Nevada in 1929, by methods of recovery

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated	24,643	6,181.39	13,259	-----	-----	-----
Ore and old tailings cyanided	488,100	73,657.12	2,432,773	8,949	-----	-----
Ore smelted	232,057	15,446.73	784,196	11,228,682	8,417,222	1,083,425
Concentrates smelted:						
Flotation	[1] 413,184	65,713.74	1,638,813	128,874,746	10,493,012	15,601,987
Table	1,162	312.24	37,980	24,430	736,243	234,671
Miscellaneous material smelted	920	283.00	15,480	2,002	46,091	-----
Total, lode mines	-----	161,594.22	4,922,501	140,138,809	19,692,568	16,920,083
Total, placers	-----	2,117.00	1,025	-----	-----	-----
	-----	163,711.22	4,923,526	140,138,809	19,692,568	16,920,083
Total, 1928	-----	175,157.79	5,481,574	158,876,883	15,747,444	6,796,713

[1] Includes concentrates from 2,550 tons of old tailings.

Mine production of metals from gold and silver mills in Nevada in 1929, by counties, in terms of recovered metals

County	Ore and old tailings treated		Recovered in bullion			
			Amalgamation		Cyanidation	
	Ore	Old tailings	Gold	Silver	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Clark	1, 730		515. 19	1, 130	508. 75	1, 129
Elko	65, 128		498. 20	550	33, 456. 28	252, 557
Esmeralda	72, 437	[1] 279, 000	518. 43	156	21, 166. 94	766, 293
Humboldt	258		64. 57	21	2. 90	1, 687
Lander	409		87. 83	73	68. 38	24
Lyon	2, 054		633. 63	516	12. 85	916
Mineral	666		95. 29	1, 130	724. 91	1, 958
Nye	72, 695	20	2, 422. 32	1, 164	13, 969. 39	1, 357, 397
Ormsby		1, 200			7. 68	49
Pershing	4, 405		26. 68	54	152. 93	43, 009
Storey	9, 862	500	1, 130. 12	8, 399	3, 540. 02	2, 951
Washoe	199		91. 84	43		
White Pine	80	2, 100	97. 29	23	46. 09	4, 803
	229, 923	282, 820	6, 181. 39	13, 259	73, 657. 12	2, 432, 773
Total, 1928	305, 718	245, 430	8, 311. 27	8, 477	72, 755. 51	2, 720, 994

County	Concentrates and recovered metal			
	Concentrates produced	Gold	Silver	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
Clark	6	87. 16	263	534
Esmeralda	8	108. 35	58	539
Lander	2	8. 83	209	
Nye	1	8. 04	74	
	17	212. 38	604	1, 073
Total, 1928	14	68. 10	912	2, 068

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[1] Yielded also 8, 949 pounds of copper contained in "cyanide" precipitates.

Gross metal content of concentrates from concentrating mills in Nevada in 1929, by classes of concentrates

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	906	580. 24	253, 703	33, 317	83, 749	
Copper	380, 435	62. 470. 60	197, 677	136, 622, 293		
Lead	12, 283	2, 303. 56	1, 117, 663	48, 134	11, 150, 509	
Zinc	20, 705	459. 20	107, 146	4, 733	656, 220	18, 152, 339
	414, 329	65, 813. 60	1, 676, 189	136, 708, 477	11, 890, 478	18, 152, 339
Total, 1928	376, 617	69, 669. 06	1, 912, 866	152, 509, 386	6, 042, 529	6, 271, 800

Nevada ore and old tailings concentrated in 1929, by methods of concentration

Method of concentration	Ore and old tailings concentrated	Concentrates and metal content		
		Concentrates produced[1]	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*
Flotation	6,601,279	413,184	65,713.74	1,638,813
Table	5,951	1,145	99.86	37,376
	6,607,230	414,329	65,813.60	1,676,189

Method of concentration	Concentrates and metal content—Continued					
	Copper		Lead		Zinc	
	Gross	Recovered	Gross	Recovered	Gross	Recovered
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Flotation	136,677,778	128,874,746	11,115,387	10,493,012	17,884,661	15,601,987
Table	30,699	24,430	775,091	735,170	267,678	234,671
	136,708,477	128,899,176	11,890,478	11,228,182	18,152,339	15,836,658

[1] Figures do not include 17 tons from ore first treated by amalgamation containing 212.38 ounces of gold, 604 ounces of silver, and 1,129 pounds of lead (1,073 pounds recovered).

Mine production of metals from concentrating mills in Nevada in 1929, in terms of recovered metals

BY COUNTIES

	Ore and old tailings treated		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	925		186	11.60	2,685	362	109,261	
Clark	2,871		468	342.56	11,328	14,648	224,392	153,277
Elko	2,320		434	3.07	11,676	9,638	310,290	64,124
Eureka	44,056		1,559	454.47	483,949	16,349	435,712	17,270
Humboldt	40		10	.40	1,295	625	6,259	
Lander	12,482		414	18.63	210,972	14,888	87,602	
Lincoln	60,807		23,799	1,011.68	337,899	2,028	5,855,681	12,995,496
Lyon	170,215	2,550	15,214	804.53	54,793	2,998,843	5.757	
Mineral	5		2	.14	129		778	1,113
Nye	54,180		6,523	708.92	337,700	983	3,982,712	2,605,378
White Pine	6,259,329		365,720	62,457.60	223,763	125,840,812	209,738	
	6,607,230	2,550	414,329	65,813.60	1,676,189	128,899,176	11,228,182	15,836,658
Total, 1928	6,198,982	73,336	376,617	69,669.06	1,912,866	144,550,172	5,452,912	5,466,586

BY CLASSES OF CONCENTRATES

Dry and siliceous	906	580.24	253,703	24,083	78,661	
Copper	380,435	62,470.60	197,677	128,839,532		
Lead	12,283	2,303.56	1,117,663	31,072	10,592,983	
Zinc	20,705	459.20	107,146	4,489	556,538	15,836,658
	414,329	65,813.60	1,676,189	128,899,176	11,228,182	15,836,658

Gross metal content of Nevada concentrates produced in 1929, by classes of concentrates

Class of concentrates	Concentrates produced	Gross metal content: Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	749	792.62	254,307	33,317	84,878	-----------
Copper	380,435	62,470.60	197,677	136,622,293	-----------	-----------
Lead	12,457	2,303.56	1,117,663	48,134	11,150,509	-----------
Zinc	20,705	459.20	107,146	4,733	656,220	18,152,339
	414,346	66,025.98	1,676,793	136,708,477	11,891,607	18,152,339
Total, 1928	376,631	69,737.16	1,913,778	152,509,386	6,044,706	6,271,800

Mine production of metals from Nevada concentrates in 1929, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	186	11.60	2,685	362	109,261	-----------
Clark	474	429.72	11,591	14,648	224,926	153,277
Elko	434	3.07	11,676	9,638	310,290	64,124
Esmeralda	8	108.35	58	-----------	539	-----------
Eureka	1,559	454.47	483,949	16,349	435,712	17,270
Humboldt	10	.40	1,295	625	6,259	-----------
Lander	416	27.46	211,181	14,888	87,602	-----------
Lincoln	23,799	1,011.68	337,899	2,028	5,855,681	12,995,496
Lyon	15,214	804.53	54,793	2,998,843	5,757	-----------
Mineral	2	.14	129	-----------	778	1,113
Nye	6,524	716.96	337,774	983	3,982,712	2,605,378
White Pine	365,720	62,457.60	223,763	125,840,812	209,738	-----------
	414,346	66,025.98	1,676,793	128,899,176	11,229,255	15,836,658
Total, 1928	376,631	69,737.16	1,913,778	144,550,172	5,454,980	5,466,586

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous	749	792.62	254,307	24,083	79,734	-----------
Copper	380,435	62,470.60	197,677	128,839,532	-----------	-----------
Lead	12,457	2,303.56	1,117,663	31,072	10,592,983	-----------
Zinc	20,705	459.20	107,146	4,489	556,538	15,836,658
	414,346	66,025.98	1,676,793	128,899,176	11,229,255	15,836,658

Gross metal content of Nevada crude ore shipped to smelters in 1929, by classes of ore

Class of ore	Ore	Gross metal content: Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	8,118	9,804.64	119,322	19,446	107,886	-----------
Copper	154,910	2,817.07	57,577	9,273,728	18,086	-----------
Lead	10,424	2,097.79	115,744	84,110	3,191,839	-----------
Zinc	177	-----------	378	100	17,646	144,417
Copper-lead	56,644	727.23	491,175	2,735,042	5,193,746	-----------
Lead-zinc	1,784	-----------	-----------	1,917	475,326	1,206,016
	232,057	15,446.73	784,196	12,114,343	9,004,529	1,350,433
Total, 1928	233,371	22,398.61	827,744	15,324,144	10,996,632	1,662,659

Mine production of metals from Nevada crude ore shipped to smelters in 1929, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	51	2.36	462	136	31,054	
Clark	2,673	112.63	7,172	32,352	855,531	1,083,425
Douglas	60	11.95	476	9,787	3,448	
Elko	10,568	742.68	66,311	718,130	1,293,886	
Esmeralda	489	399.43	7,527	12,013	57,803	
Eureka	5,205	1,880.13	37,618	25,568	755,766	
Humboldt	346	1,229.82	37,191	22,914	817	
Lander	14,268	945.47	23,406	2,442,402	48,289	
Lincoln	59,447	755.64	507,862	2,648,264	4,998,570	
Lyon	7,492	220.60	3,083	284,506	440	
Mineral	1,260	1,188.88	33,950	56,536	39,258	
Nye	4,178	5,404.48	15,877	2,852	192	
Ormsby	19		18	1,634		
Pershing	293	126.40	4,170	27,975	36,102	
Storey	882	645.26	21,049	2,611		
Washoe	123	19.41	1,874	7,724	12,361	
White Pine	124,703	1,761.59	16,150	4,933,278	283,705	
	232,057	15,446.73	784,196	11,228,682	8,417,222	1,083,425
Total, 1928	233,371	22,398.61	827,744	14,317,763	10,284,619	1,330,127

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous	8,118	9,804.64	119,322	14,507	98,385	
Copper	154,910	2,817.07	57,577	8,827,225	9,982	
Lead	10,424	2,097.79	115,744	62,735	3,032,232	
Zinc	177		378	70	12,536	118,613
Copper-lead	56,644	727.23	491,175	2,322,866	4,931,359	
Lead-zinc	1,784			1,279	332,728	964,812
	232,057	15,446.73	784,196	11,228,682	8,417,222	1,083,425

REVIEW BY COUNTIES AND DISTRICTS

CHURCHILL COUNTY

Alpine district.—The Nevada Gold group of three claims in Stone Canyon, Alpine district, is developed by a 300-foot tunnel. A small lot of mixed crude ore and concentrates containing gold, silver, lead, and zinc was hauled 93 miles west to Fallon for shipment to a smelter in Utah. The ore also contained antimony and molybdenum.

Broken Hills (Hot Springs) district.—The Silver Butte claim in the western foothills of Mount Annie yielded 7 tons of lead ore containing silver. The ore was shipped to a smelter in Utah. At the Broken Hills mine the shaft was sunk an additional 100 feet, and about 1,100 feet of drifting was done in 1929.

Copper Kettle district.—Eleven tons of copper ore shipped to the smelter from the Copper Kettle mine yielded 8 ounces of silver and 1,600 pounds of copper. Chalcocite, copper oxides, and copper carbonates predominate in ore occurring near a contact of diorite with overlying altered porphyry. The mine is in Grimes Canyon on the west slope of the Stillwater Range.

Fairview district.—At the mine of the Chalk Mountain Silver-Lead Mines Co., 45 miles east of Fallon in the Fairview district, development was continuous during the year. The company completed its 50-ton gravity concentration mill in May. It experimented on ore from its mine and found it possible to make a good recovery of silver and lead although the mill was originally designed to recover vanadates and other rare minerals. Lead concentrates and some crude ore were shipped to smelters in Utah and California. Development of the Chalk Mountain West Side mine and the Heritage claim of the Chalk Mountain Mining Co. was continued.

CLARK COUNTY

Charleston district.—A lessee shipped a small lot of lead ore to Utah from the Griffeth property in the Charleston Mountain region. The ore was probably sorted material and contained 3.65 ounces of silver to the ton, 41.5 per cent of lead, 21.2 per cent of zinc, and 6.4 per cent of sulphur.

Copper King district (*Bunkerville*).—Ore from the Key West mine dump was treated experimentally in a small concentration plant equipped with a ball mill, 8-cell flotation unit, and Wilfley tables. Copper concentrates, containing 10 per cent of copper and some gold and silver, were shipped to a smelter. An attempt was made to make nickel-platinum concentrates. The mill was dismantled later in the year. The output of crude ore mentioned in the 1928 report was shipped directly to an ore buyer at Salt Lake City and reported by the owner to contain gold, copper, platinum, palladium, nickel, and cobalt.

Eldorado Canyon district.—Three lode mines in the Eldorado Canyon district produced 2,207 tons of ore yielding $29,653 in gold, 9,813 ounces of silver, 264 pounds of copper, and 3,860 pounds of lead, valued in all at $35,172, or $15.94 in metals a ton. The larger part of the metal output contained in mill bullion and concentrates came from the Eldorado Rand property. The company operated its 10-stamp mill six months, treating ore by amalgamation, concentration, and cyanidation. About 800 feet of new work was done in the mine. At the Techatticup, lessees treated ore by flotation; lead concentrates were recovered averaging 37.7 ounces of gold and 506 ounces of silver to the ton, and 1.6 per cent of copper, 7.8 per cent of lead, 12 per cent of zinc, and 18 per cent of sulphur. The mine is opened by an inclined shaft 600 feet deep, but no new development was reported in 1929. In the Nob Hill section the Gold Star property was under lease to the Nob Hill Mining Co. A small lot of lead-silver ore was shipped. At the Wall Street property the Eldorado Canyon Development Co. sank a vertical shaft 160 feet and did 80 feet of drifting.

Searchlight district.—In 1929, lessees on the Duplex, J. E. T., and Redbird properties in the Searchlight district milled 150 tons of ore and shipped 34 tons of siliceous ore to a smelter, together yielding gold, silver, copper, and lead, valued in all at $2,495. Development work was reported in the New Year mine, where 60 feet of additional drifting was done.

Yellow Pine district (*Goodsprings*).—Fourteen lode mines produced 4,618 tons of ore yielding $469 in gold, 11,067 ounces of silver, 33,382 pounds of copper, 1,070,718 pounds of lead, and 1,236,702 pounds of zinc, valued in all at $161,320, or $34.93 in metals a ton. Most of the output was milling ore, of which part was treated in the Yellow Pine district and part was shipped to custom mills in Utah. Altogether, 1,941 tons of ore was treated in concentration mills and yielded 398 tons of concentrates, of which 123 tons was lead concentrates recovered by flotation and 107 tons was lead concentrates and

168 tons was zinc concentrates recovered by gravity concentration. First-class smelting ore amounted to 2,597 tons, of which 1,784 tons was classified as lead-zinc ore and yielded 1,279 pounds of copper, 332,728 pounds of lead, and 964,812 pounds of zinc; 177 tons was zinc ore and yielded a little silver and copper, 12,536 pounds of lead, and 118,613 pounds of zinc; and 553 tons was lead ore, 81 tons was copper ore, and 2 tons was gold ore. The Robins lease on the Potosi mine reported shipments of lead-zinc ore of milling and smelting grade. Milling operations in the district were confined to the Argentena Consolidated, which had a 60-ton concentrator testing the ores experimentally. The new mill of the Yellow Pine Mining Co. was nearly completed and replaces the plant destroyed by fire earlier in the year. The new mill was designed to treat by flotation 100 tons of ore daily. The Yellow Pine Mining Co. estimates a reserve of 100,000 tons of milling ore on dumps and in mine. Lessees operated the Goodsprings Anchor property and worked its ore with jigs and tables part of the year. The concentrates produced were mixed with crude ore shipped to smelters. The 50-ton Stebbins dry mill at the Anchor mine was out of service. Lead-zinc ore was shipped from the Milford and Addison and the Rosila properties; the Rosila also produced copper ore. Copper ore was also shipped from the Azurite, Red Streak, and three other claims. A little gold bullion from the old Keystone mine was produced during an investigation of the property by the Commonwealth Mining Co.

DOUGLAS COUNTY

Buckskin district.—Some sulphide copper ore of 5.5 per cent grade with a little gold was shipped from the Buckskin Consolidated property direct to a smelter in Utah. The property is in the north end of Smith Valley in the Buckskin district, which extends into Lyon County. Yerington is the nearest post office.

Mount Siegel district.—Only assessment work was reported by the owner of the Buckeye placer property, which has been a continuous producer of some gold each year. The placer is at an altitude of 7,100 feet and the season for placering is claimed to be short.

Red Canyon district.—Two lots of oxidized ore containing principally silver and a little gold and some lead were shipped to the smelter from the Lucky Bill and one other property in the Red Canyon district.

ELKO COUNTY

Centennial district.—Some gold bullion was recovered from a small lot of Lucky Girl ore treated by amalgamation.

Contact (*Salmon River*, *Porter*) *district.*—Ten lode producers in the Contact district produced 5,786 tons of ore yielding $1,997 in gold, 11,135 ounces of silver, 606,660 pounds of copper, and 55,628 pounds of lead, valued in all at $118,209, or $20.43 in metals a ton. The Seattle Contact Copper Co. operating the Delano group was the principal producer of copper ore, shipping 3,924 tons to the copper smelters near Salt Lake City. Included with the ore shipped was one lot of copper precipitate from a leaching plant operated experimentally. The Gray Mining Co. shipped to the smelter 456 tons of copper ore; 220 tons went to the smelter from the Gray claim. There were shipments of copper ore also from the Arizona, Brooklyn, Hanks, Lewis, Liberty Bell, and Queen of the Hills groups. The Arizona and Hanks properties are in the Porter section of the Contact district.

Cope district.—The Nelson and Mountain City claims owned by the Silver Banner Mining Co. were under development in 1929 and a small lot of silver ore was shipped to a Utah smelter. The property is equipped with a 100-ton flotation mill which was not operated.

Delano district.—Two lode mines were producers of lead ore, part of which was of milling grade. The Panther Mines Co., operating the Net mine, shipped table concentrates recovered in its 25-ton milling plant. The total ore produced from the mines in the Delano district in 1929 amounted to 2,365 tons, yielding gold, silver, and lead valued in all at $56,707, or $23.98 in metals a ton. The shipments of smelting ore and concentrates were made by autotruck to Montello, a station on the Southern Pacific Railroad 35 miles south of the mine. The work on the Blue Lead and Cleveland properties consisted of prospecting underground 300 feet below the outcrop.

Gold Circle district (*Midas*).—Four producers, the Gold Circle Consolidated, the Esperanza, the Black Cloud, and the Gold Circle Queen, reported 13,913 tons of ore which yielded $120,078 in gold and 82,588 ounces of silver, valued together at $164,097, or $11.79 in metals a ton. All of the ore was milled, the larger part in the 80-ton countercurrent cyanide plant of the Gold Circle Consolidated. Some of the ore was treated in a custom amalgamation plant. The Gold Circle mill was in operation until August, when it was shut down pending further development of the mines. The mine is opened by several tunnels and shafts, the deepest of which is 750 feet.

Granite district.—At the Dolly Varden property, 12 miles west of Wendover in the Granite district, some development was done by lessees during the year. About 250 tons of copper and copper-lead ore was shipped to a smelter.

Jarbidge district.—The Elkoro Mines Co., a subsidiary of the Yukon Gold Co., controls a large part of the productive mineral area of the Jarbidge district. Development of the Long Hike, Starlight, and other claims was continued and the 100-ton cyanidation plant was operated. According to the printed report of the Yukon Gold Co. for the year ended December 31, 1929, 50,458 tons of ore was treated, averaging $13.10 a ton in gold and silver with a recovery value of $661,043.78. The net operating profit amounted to $314,008. The following paragraph is from the company's annual report:

> The development work done during the year failed to add to the ore reserves and it now appears that this mine will be exhausted by the end of 1931, unless additional ore be meanwhile developed. As a result of unfavorable exploratory results during the year just past, the outlook for finding such additional ore does not appear promising.

The Success and Bluster properties were developed and gold ore was produced by lessees, who treated it by amalgamation in the Bluster mill.

Lime Mountain (*Deep Creek*) *district.*—The Lime Mountain mine, 72 miles north of Elko, was a producer of 897 tons of copper ore shipped directly to a smelter in Utah. The ore assayed 0.702 ounce of gold and 2.8 ounces of silver to the ton and 2.83 per cent of copper. The mine is an old one, having been discovered some 50 years ago, and is opened by several tunnel levels.

Merrimac (Lone Mountain) district.—Lessees working the Rip Van Winkle property in the Merrimac district produced 16 tons of lead ore containing over 100 ounces of silver to the ton. The property is owned by the Alaska Improvement Co.

Mud Springs district.—The Silver Butte property and the Al Smith claims in the Mud Springs district were under development and produced lead ore which was hauled 30 miles west to Currie on the Nevada Northern Railway. More than 600 tons of the ore was tested at a flotation custom plant near Salt Lake City, and 13 tons of ore was directly smelted. The total value of the entire output in recovered silver and lead was $2,250.

Railroad district.—While doing development work in the Railroad district the Grey Eagle Mining Co. produced 238 tons of milling ore averaging 6 per cent of zinc, 5 ounces of silver, and a little copper and lead, which was tested in a flotation plant near Salt Lake City. Zinc concentrates and lead concentrates were recovered.

Rock Creek district.—The Divide mine of the Ruby Silver Gold Mines Co. was the only producer of ore in the Rock Creek district in 1929. This ore, which carried considerable silver and a little gold, was hauled 68 miles to the railroad and shipped to a Utah smelter. Rock Creek is 12 miles west of Tuscarora, but Midas is the nearest post office.

Ruby Mountain Range district.—Lead ore and some lead concentrates were shipped to a smelter in Utah from the L. C. property in the Ruby Mountain Range district. Owing to defective equipment the concentrator was abandoned after operating about 120 hours.

Spruce Mountain district.—All the ore produced by five lode mines in the Spruce Mountain district amounted to 2,530 tons and was shipped directly to mills and smelters in Utah. The ore and concentrates yielded $104 in gold, 23,890 ounces of silver, 34,148 pounds of copper, 776,131 pounds of lead, and 42,293 pounds of zinc, valued in all at $70,534, or $27.88 in metals a ton. The milling ore, of which 184 tons was shipped for testing purposes, produced lead and zinc concentrates and was chiefly from Nevada Lead & Zinc property, which also produced considerable lead ore of smelting grade. In July, the Black Forest mine was consolidated with the Missouri Monarch Consolidated Mines Co. The Black Forest adit is now 2,400 feet from the portal, and the Spruce Monarch tunnel was driven 1,500 feet eastward. The Nevada Lead & Zinc property was in operation the full year and produced 400 tons of ore a month, averaging 18 per cent of lead and 5 ounces of silver a ton. All the ore came from between the 70 and 160 foot levels. The other producers were the Bullshead, Humbug, and Spruce Standard mines. The survey for a railroad to be constructed to the Spruce Mountain mining district, 24 miles north from Ventosa, was completed.

Tecoma district.—The Jackson mine produced two cars of 25 per cent lead ore; the ore was shipped by the owner of the mine.

ESMERALDA COUNTY

Castle Rock district.—Shipments of siliceous gold ore were made from the Pans and other claims to the cyanidation plant near Tonopah.

Desert district (Gilbert).—The total output of the Desert district amounted to 449 tons of ore yielding $13,991 in gold, 2,791 ounces of silver, 7,126 pounds of copper, and 1,916 pounds of lead, valued in all at $16,854, or $37.54 in metals a ton. The Last Hope and Homestake groups were operated by lessees who shipped gold ore to the cyanide plant near Tonopah. Some lead ore from the Carrie property was shipped to California and Utah.

Divide district.—Three lode mines produced 5,908 tons of ore yielding $25,942 in gold and 151,295 ounces of silver, valued together at $106,582, or $18.04 in metals a ton. The largest producer was the Tonopah Divide, followed by the Brougher Divide and Gold Zone properties.

Goldfield district.—Ore from two lode mines, sorted ore from old mine dumps, and old tailings yielded $263,947 in gold, 5,946 ounces of silver, and 10,805 pounds of copper, valued in all at $269,018 in 1929. This output of metal was contained in 295 tons of gold ore shipped to a cyanidation plant near Tonopah; 204 tons of siliceous ore, 14 tons of copper ore, and some mill sweepings shipped to a smelter in Utah; and 279,000 tons of old tailings. Most of the copper output of the district came from ore sorted from old mine dumps on claims of the Goldfield Deep Mines Co. and from mill tailings of the Goldfield Consolidated Mines Co. The latter company leased its tailings dump, said to contain 1,500,000 tons, to the Bradshaw (Inc.), which began operations in June, 1927, and to the end of 1929 the tailings treated by cyanidation amounted to 657,000 tons. To treat these tailings most of the old Goldfield Consolidated milling equipment was used. The tailings are sluiced into a sump, screened to remove weeds, etc., then pumped up to the mill in two stages—an initial one of 100 feet by an 8-inch Wilfley pump and a second one of 70 feet by an 8-inch Morris pump to cone-bottom thickeners. The excess solution goes into the sluicing circulation and the pulp to two stock tanks with mechanical agitators, then to Butters filters. About 70 per cent of the recovery is said to be obtained during filtration of the solution. The reagents used in the mill were sodium cyanide, zinc dust, and lime. Operation continues only in seasonable weather, as the material treated balls up when cold; from March until late in December 279,000 tons of old tailings were handled. Gold and silver precipitates were shipped, yielding 12,136 ounces of gold, 5,543 ounces of silver, and some copper, valued in all at $255,094, or an average recovery value of 91.4 cents a ton. The Bradshaw precipitate shipped to a smelter averaged 46.5 per cent of copper, which was originally associated with the richer gold ore of the Goldfield mines, mostly found in famatinite,[3] a copper-antimony sulphide mineral.

The Goldfield Consolidated mine was leased in small blocks to miners, who shipped some siliceous gold ore to a mill at Tonopah, to the Mason Valley smelter at Thompson, and to smelters in Utah.

Klondyke district.—From the old workings of the Original Klondyke mine 18 tons of ore was shipped yielding 2,600 ounces of silver and a little copper.

Lone Mountain district.—The Copper Queen group of claims was a producer of 6 per cent copper ore taken out in development of the property, 3½ miles south of Barrel Springs.

Montezuma district.—From the Buffalo Hump and Monitor claims small lots of ore amounting to 44 tons were shipped to smelters in Utah. The ore yielded a little gold, 1,351 ounces of silver, 42,534 pounds of lead, and a little copper, valued in all at $3,444, or $78.27 in metals a ton.

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[3] Ransome, F. L., Geology and Ore Deposits of Goldfield, Nev.: United States Geol. Survey Prof. Paper 66, 1909, p. 118.

Palmetto (Windypah) district.—Gold ore carrying 2 ounces of gold, 16 ounces of silver, and a little copper was shipped by lessees to the smelter from the Old Palmetto property in the northwest part of the Palmetto district. According to Lincoln,[4] who describes the district, the Palmetto mine is credited with a production of $6,500,000 in silver.

Silver Peak district.—Five lessees of lode mines reported 2,765 tons of ore yielding $25,221 in gold, 1,805 ounces of silver, and 539 pounds of lead, valued in all at $26,217, or $9.48 in metals a ton. Most of the ore produced in 1929 came from the Mary mine, operated under a long-term lease by the Lucky Boy Divide Mining Co., which in turn is controlled by the Black Mammoth Consolidated Co.

This company operates on its own account and sublets part of the ground. The Indian Mines Co., one of the lessees, reported a production in December of $12,800 in gold and silver, which was recovered in the Black Mammoth mill; the Liberty Divide Mining Co. mined in the Mary Savage section of the property and took out gold-silver ore of smelting grade which was shipped to a Utah smelter. The Black Mammoth mill was equipped with a gyratory crusher, rolls, Hardinge ball mill, Dorr classifier, K & K flotation cells, and 2 Wilfley tables. Some of the ore from the Mary mine was treated by amalgamation and gravity concentration in the Fanchini mill operated by the lessees. Beginning in June ore from the Valcalda-Oromonte property was treated in its new mill. Nearly 1,000 tons of ore was treated and some was shipped. The mill has a Telsmith crusher and amalgamating plates, a Hardinge ball mill, Akins classifier, Overstrom table, 4 Kraut flotation cells, and 2 agitation vats.

Sylvania district.—The Oasis Mining Co., operating in Nevada 13 miles southeast of Oasis, Calif., was a producer of lead ore, containing silver and a little gold, which was shipped to Midvale, Utah.

Tonopah district.—In 1929 most of the mining on the Esmeralda County side of the Tonopah district was by the Tonopah Extension Mines Co. and its successor, the Tonopah Extension (Inc.). The figures of output are included in the Tonopah district review under Nye County.

EUREKA COUNTY

Cortez district.—Four lode mines in the Cortez district produced 44,322 tons of ore yielding $10,650 in gold, 493,766 ounces of silver, 17,990 pounds of copper, 435,990 pounds of lead, and 17,270 pounds of zinc, valued in all at $305,600, or $6.89 in metals a ton. The Consolidated Cortez Silver Mines Co. was the largest producer of metals. The company operated its 150-ton flotation plant and produced lead-silver concentrates that were hauled 35 miles to Beowawe on the Southern Pacific Railroad for shipment to a Utah smelter. The treatment in the mill consisted of crushing in a gyratory crusher, grinding in ball and pebble mills to 200 mesh, and treatment in five Parker cells. This plant was first built for cyanidation but was changed to flotation in 1927. All the cyanide equipment is in place, and only that part which could be adapted to flotation was used.

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[4] Lincoln, F. C., Mining Districts and Mineral Resources of Nevada: 1923, p. 79.

The mine is opened by a 3,200-foot tunnel, 300-foot inclined shaft, and drifts on three levels. About 2,950 feet of development was done in 1929. The mine was closed January 15, 1930, pending an improvement in the price of silver.

Reference to the production and costs was given in the company's 1929 printed annual report, from which the following paragraphs are taken:

> During 1929 we have milled 43,808.3 tons of ore which averaged 13.96 ounces silver to the ton, and on which we made an average mill recovery of 75.06 per cent. The recovered value of the products was $286,234.55. The operating cost was $338,326.70, incidental profits from rents, boarding house, etc., were $338.23, which leaves an operating loss for the year of $51,753.92.
>
> A total of 950.3 feet of development work was done, of which shaft sinking accounted for 120 feet, raising from 1,000-level to 736-level, 274 feet, and the remaining 1,596.3 feet in drifting on the 1,000 or Arctic level, the 1,100 and the 1,200 levels.
>
> Our total production in terms of silver, with the gold, lead, and copper converted to equivalent ounces of silver on the basis of the average prices of the metals for each month, has been 537,689.95 ounces.
>
> Total operating costs for the year have averaged $7.798 per ton milled, which was divided as follows: mining cost $3.660 per ton; milling cost, $1.657 per ton; marketing cost, $1.474 per ton, and office, superintendence and general expense, $1.007 per ton. * * *
>
> The average price received for silver for the year was 53.263 cents per ounce, dropping from 57.275 cents in January to 48.708 cents in December. * * *
>
> Average mill extraction for the year has been 75.06 per cent, which is 15 per cent below what was expected of the flotation plant, and probably 10 per cent below what should be considered good practice. Milling costs for the year averaged $1.657 per ton, which includes cost of all repairs, alterations, and additions to the milling plant.
>
> Tailings loss from the mill on the basis of average recovery has been 3.48 ounces per ton, which is equivalent to 142,817.24 ounces, or on the basis of the average price received for silver, $76,068.75. If our milling practice was such that we could have made an 85 per cent recovery, as we should have, this loss would have been reduced to $48,883.81, which saving would have cut our operating loss for the year in half. * * *
>
> Lack of developments ahead of stoping operations increases the cost of mining. Obviously, with a low price for our products the cost of producing them must be lowered accordingly, and it is the low-cost mines that survive the periods of low metal prices. The mining method we use is the cheapest method of attack possible, provided the stopes can be handled properly. To get the desired results, we must have at least three stopes opened at one time; one completely mined, ready to pull, to insure a steady tonnage, another completely developed and in the mining stage which produces only that tonnage represented by the increase in volume between broken ore and ore in place, and the third in the development stage. Mine development must be far enough ahead to insure this condition in order to keep our mining costs as low as possible. It is estimated that total mining costs should not exceed $2 per ton if the above condition existed, as against an average of $3.66 for the year. * * *
>
> It has cost $1.474 per ton milled to market our products, which includes haulage to Beowawe, railroad freight to Salt Lake, smelter charges and losses in smelting. This cost is 18.8 per cent of the total cost of production. The cost of marketing is largely a factor of milling results. A higher ratio of concentration with a consequent higher grade of concentrate reduces the marketing cost in proportion to the volume of concentrate produced.

Other mines producing near Cortez were the Keystone and Rico. The Mount Tenabo property, operated by the Majestic Mines Corporation, also produced. Some of the ore from these mines was of milling grade and was shipped to Utah custom concentration mills, which treated the ore chiefly by flotation.

Eureka district.—Four lode mines in the Eureka district produced 4,981 tons of ore and old tailings in 1929, yielding $37,611 in gold, 27,760 ounces of silver, 20,874 pounds of copper, and 755,488 pounds of lead, valued in all at $103,677, or $20.81 in metals a ton. All of the ore was of smelting grade, and the entire output was shipped to smelters in Utah. The Richmond-Eureka property, operated by lessees, produced the greater part of the output of the district. Three lots of lead ore were shipped from the Bear mine, which is opened by a vertical shaft 150 feet deep.

Lynn district.—The Bulldog placer in the Lynn district was a consistent producer of gold during 1927, 1928, and 1929. Other placer production credited to the district and including the Bulldog placer output for the last three years amounted to 279.41 fine ounces of gold and 11 ounces of silver. Part of the output was sold to the United States assay office at Salt Lake City, Utah. The season during which the placers were worked in 1929 was from the last of March to May 15.

Safford district.—The Mayflower claim in the Safford district produced 8 tons of 19 per cent copper ore, which was shipped to Garfield, Utah.

HUMBOLDT COUNTY

Amos (*Slumbering Hills*) *district.*—The amalgamation mill at Daveytown was operated on ore from the Sleeping Beauty property, 8 miles southwest of Amos. About 14 tons of ore was treated and yielded 8 ounces of gold and silver bullion.

Gold Run (*Adelaide*) *district.*—The Big Four, Lucky Boy, and Golden Stairs claims in the Gold Run district, 18 miles south of Golconda, were producers of ore amounting in all to 66 tons, valued at $1,503 in gold, silver, and a little lead. The ore was shipped to the smelter at Thompson and one small lot of ore was treated by amalgamation.

Iron Point district.—During development of the Myrtle mining claim 224 tons of copper ore was produced and shipped to a smelter in Utah. Some silver ore was also shipped from the Silver Coin mine.

National district.—Lead concentrates containing silver and a trace of gold from ore recovered at the National Consolidated mill in 1928 were shipped to a smelter in Utah. Some sorted gold-silver ore was also shipped from the Buckskin mine. The 50-ton flotation plant recently erected for treating Buckskin ore was not a success.

Preble (*Potosi*) *district.*—The Dolomite property in the Preble district, 5 miles east of Golconda, produced 140 tons of oxidized ore containing gold and silver, which the lessees treated by cyanidation.

Sherman district.—The Basque Mining & Milling Co. reported development on a small scale at its mine in the Sherman district and lengthened its two tunnels by 190 feet of work. The mine is opened for more than 600 feet by the upper tunnel on the vein of gold quartz which crops on the surface, and the lower tunnel level is driven more than 800 feet.[5] Ore sufficient to warrant a 30-ton mill is reported to be developed; construction of the mill is expected to be begun early in 1930.

LANDER COUNTY

Battle Mountain district.—The metal output from lode and placer mines in the Battle Mountain district consisted of $16,448 in gold, 28,190 ounces of silver, 2,431,614 pounds of copper, and 46,500 pounds of lead, having a total value of $462,366. Nineteen lode mines yielded 15,696 tons of ore, of which 409 tons were treated in gold and silver mills and 1,500 tons in flotation plants. Concentrates from flotation cells and tables amounted to 60 tons and were shipped with 13,787 tons of gold ore, copper ore, and lead ore to the smelters in Utah and to the Mason Valley smelter at Thompson. The Copper Canyon Mining Co. had the largest production of copper ore, mined by numerous lessees from the Copper Canyon and Copper Basin properties. These mines produced in recovered metals in 1929, 2,041,344 pounds of copper, 8,747 ounces of silver, and 191.29 ounces of gold. Copper ore was also shipped from the Copper Queen, under lease to the Consolidated Metals Corporation until December 1, and from two other properties—the Effee on Alder Creek and the Mesa Copper claims owned by the Ruth Mining Co. The Copper Queen mine, which is opened by an inclined shaft for 200 feet, produced over 2,500 tons of ore averaging 6 per cent copper. Lead ore containing silver was shipped from the Snowstorm mine and five other claims. The Buckingham Mines Corporation reported development work on its property near Battle Mountain, which consisted of sinking its 800-foot inclined shaft an additional 200 feet. The 100-ton flotation plant was operated a short time and one car lot of concentrates was produced. At the cyanide mill of the Buffalo Valley Mines Co. about 300 tons of gold ore was tested and some gold and silver were recovered. The placer output of the district was $4,406 in gold and 29 ounces of silver, valued together at $4,421; it resulted chiefly from dry placer mining at the Dahl, Homestake, and other claims in Copper Canyon.

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[5] Nevada Mining Press, Mar. 28, 1930.

Bullion district.—Three lode mines produced 72 tons of ore compared with 105 tons in 1928. Ore produced in 1929 yielded $818 in gold, 1,298 ounces of silver, 2,601 pounds of copper, and 11,283 pounds of lead, valued in all at $2,679, or $37.21 in metals a ton. Most of the copper ore was from the Gylding and Ajax group of claims, 22 miles south of Beowawe on the west side of Crescent Valley. The Utah mine, operated by the Nevada Central Mining Co., yielded 18 tons of silver-lead ore containing a little copper and gold.

Lewis district.—The low price of silver caused the Betty O'Neal Mines Co. to discontinue production on company account and close its milling plant in January. The No. 4 and No. 5 tunnel levels of the mine were turned over to lessees, who worked on equal shares with the company, the latter furnishing all supplies. The flotation mill on the property was operated at intervals as a custom plant.

McCoy district.—The Gold Dome Mining Co. worked the McCoy group of claims, which is opened by a vertical shaft 265 feet deep and 600 feet of drifts. The output in 1929 was 361 tons of ore, containing principally gold and silver with a little copper and lead. The mine is 32 miles by road southwest of Battle Mountain, the shipping point.

LINCOLN COUNTY

Comet district.—From the Mountain Lion property a small lot of lead ore was shipped to a smelter in Utah.

Groom district.—The Nevada Silver-Lead Co. operated the Groom mine, and arrangements were under way to mill some of the mine-dump material. Meanwhile, shipments of crude ore containing 28 to 46 per cent of lead were made to smelters in Utah. The dump ore and ore from the old stopes are reported to contain 8 per cent of lead and 10 ounces of silver to the ton.

Jack Rabbit district.—The Bristol Silver Mining Co. in the Jack Rabbit district ranked second as a producer of lead in Nevada in 1929. The company reported a production of 58,300 tons of ore.

Pahranagat district (Hiko).—The Rosie group of claims near Hiko was under development for 10 months and produced 41 tons of copper-lead ore containing silver.

Pioche district.—Three producers of ore in the Pioche district reported the output of 62,512 tons of ore and old tailings yielding $22,760 in gold, 347,008 ounces of silver, 12,513 pounds of copper, 5,972,977 pounds of lead, and 12,995,496 pounds of zinc, valued in all at $1,443,918, or $23.10 in metals a ton. Most of the ore came from the Combined Metals Lease, in which the National Lead Co. is reported to own a half interest. Recently great bodies of ore containing silver, lead, and zinc which occur as bedded deposits in limestone are being mined. The five known mineralized beds have been found to extend southwest for a considerable distance. In 1929 the mine produced ore on every level from the 700 to the 1,200, inclusive. The 1,450-foot shaft was sunk 50 feet deeper. Some good copper ore was opened on the 1,050 and 1,100 levels. At the Raymond-Ely and Meadow Valley mines churn drilling developed ore containing lead, silver, and zinc. One drift on the 225-foot level was driven eastward to intersect the limestone bed in which the Combined Metals ore is found. At the Pioche Mines Consolidated the work was chiefly experimental, on ores from different mines and dumps. In September the mill and office were destroyed by fire. Some lead concentrates recovered on tables and in flotation cells were shipped. A lessee shipped 17 cars of old tailings from the Bullionville mill dump of the Prince Consolidated Mining Co.

Tem Piute district.—The Tem Piute mine was worked by a lessee, who shipped a small lot of lead ore.

LYON COUNTY

Mason Pass district.—From the Copper Farm claim, 8 miles southeast of Yerington, 9 tons of 12 per cent copper ore was shipped to the Mason Valley smelter.

Palmyra district (Como).—The Pony Meadows Mining Co. treated gold ore by amalgamation in a pilot mill on its property northeast of Como. The company was reported ready to add a Marcy ball mill, classifier, and flotation cells. Thirty-nine tons of gold ore was shipped to a smelter.

Silver City district (Dayton).—Twelve lode mines in the Silver City district produced 4,605 tons of ore and old tailings, yielding $23,833 in gold, 27,892 ounces of silver, 11,023 pounds of copper, and 4,022 pounds of lead, valued in all at $40,892. The output consisted of 2,054 tons treated at gold and silver mills, for the most part by amalgamation. Some concentrates were recovered from Old Douglas tailings treated in the Dayton Syndicate mill, which was closed indefinitely during the year. The only other important production of gold and silver ore was from the Buckeye lease and the Oest group. All of the ore from these properties was treated in the Trimble

18-stamp amalgamation mill, and ore from the Emma, Badger, High-grade Fraction, Pedroli, and Flora Temple claims was treated in a custom mill.

Talapoosa district.—The Appian Mines Co. operated its 50-ton flotation mill to the end of 1929 and shipped to a smelter high-grade silver concentrates with some crude ore. The mill is equipped with 1 ball mill, 4 flotation cells, filter, dryer, and 1 table concentrator.

Yerington district.—Five lode mines in the Yerington district produced 170,591 tons of ore yielding $3,411 in gold, 2,915 ounces of silver, and 3,270,348 pounds of copper, valued in all at $580,546, or $3.40 in metals a ton. Most of this ore was from the property of the Mason Valley Mines Co., and was concentrated by flotation in the company's Blue Stone mill. The copper concentrates and crude ore were smelted in the company's furnaces at Thompson. Custom ores, such as were needed for fluxing, were purchased and shipped from many districts in Nevada and California during the operation of the smelter. Copper ore from the mine of the Empire Nevada Copper Mining & Smelting Co., amounting to nearly 2,000 tons in 1929, was smelted at Thompson, and also 7 tons of copper ore containing silver was hauled from the Homestake claim, 5 miles north of Hudson. In accordance with its announcement earlier in the year the Mason Valley Mines Co. discontinued the purchase of ores in March and at a stockholders' meeting on April 22 voted to discontinue operation of the mines, mill, and smelter, distribute the assets, and dissolve the corporation. Work was discontinued June 18, and the mines and equipment of the company were sold to the Eastern Iron & Metal Co. of Salt Lake City, Utah. The latter company gave leases to several operators, who shipped some copper ore to smelters in Utah.

MINERAL COUNTY

Aurora district.—A small shipment of lead ore of smelting grade was shipped to a smelter from the Hypo claim in the Aurora district.

Bell district (Simon).—In 1929 the Olympic property was worked by a lessee who shipped gold ore to the cyanidation plant near Tonopah and gold ore of a higher grade to a smelter in Utah. About 200 feet of new development was done on the property. The Simon Silver-Lead Mines (Inc.) continued development work in 1929 and made no attempt to operate the flotation mill. The company reported that new ore was found on the 800-foot level in the 811 drift, which was advanced several hundred feet farther to the west. The company's printed report for 1929 states:

> * * * A four-foot vein of copper-lead-zinc ore, which since the first of the present year we have been testing out in depth with a second winze, known as the 816 winze. This latter winze is now down 105 feet, having followed continuous ore the entire depth, the ore being of much better grade than anything we have encountered in the past. The appearance of copper in this new section of the mine, with an increase of silver values, is something new in the development of the Simon mine, as it is the first time that we have encountered appreciable copper in the ore, and coming in on the lower levels, greatly improves the outlook. * * * The average grade of ore for the entire depth of this winze has been 12 ounces of silver, 12 per cent lead, 7½ per cent zinc, 2½ per cent copper, and one dollar gold per ton. Further evidence of copper was indicated on the lower level when we recently encountered a small bunch of copper ore some 600 feet to the east of the main copper showing. Although amounting to only a few mine cars of ore, it was similar in character to the copper ore encountered in the 816 winze. This bunch of ore was high grade, averaging $1.20 gold, 22.7 ounces

silver, 21.2 per cent lead, 14.2 per cent zinc, and 5 per cent copper. The appearance of copper in the ore at two widely separated points on the lower levels adds materially to the possibility of developing ore bodies in depth having a much higher grade than the old upper level low grade ore bodies.

Buena Vista district.—Some milling ore containing silver, lead, and zinc and one lot of lead ore was shipped to Midvale, Utah, from mining claims near the Indian Queen mine in the Buena Vista district. The ore was sacked and packed on burros to the bottom of the canyon, and was hauled thence by autotruck to the railroad.

Candelaria (*Columbus*) *district.*—The Argentum Mining Co. was reported[6] actively developing new ore, mostly sulphide, on the 1,700 and 1,900 foot levels of its property near Candelaria. The ore body, 8 to 16 feet in width, was found on the footwall of the vein and was followed in a winze sunk below the 1,700-foot level. A crosscut disclosed 3 feet of ore assaying 311 ounces of silver to the ton.

Fitting (*Acme*) *district.*—The Lady Luck claim in Mormon Canyon was under development and a small lot of silver-lead ore was shipped to a smelter in California.

Garfield district.—Two lode mines, the Mable and Garfield, were operated in the Garfield district, and 455 tons of gold-silver ore and lead ore were shipped to smelters in Utah. The Lancashire claim of the Garfield mine was operated by the Tonopah 76 Consolidated Mining Co.; its output consisted of lead ore containing considerable silver with a little copper and gold. The Mable mine, owned and operated by the West End Consolidated Co. of Tonopah, has been a consistent producer for several years. The smelting ore mined in 1929 contained considerable silver and gold and some copper and lead. There was some milling ore shipped from one of these mines to the Midvale flotation plant near Salt Lake City as a test for the recovery of lead and zinc.

Hawthorne and Pamlico districts.—Four lode mines in the Hawthorne district and one in the Pamlico district produced 104 tons of ore yielding a little silver and copper valued at $2,041. Although the Lucky Boy property of the Hawthorne Mines (Inc.) was not in operation, a test lot of ore was shipped by a lessee from the mine dump. The Elmorlu group produced sulphide ore containing gold, a little silver, and copper. Small lots of gold and silver bullion were recovered from ore treated in the Pamlico amalgamation mill.

Rand district.—Three producers in the Rand district reported the shipment of 183 tons of ore. Most of the ore was from the Copper Mountain property and was shipped to the Mason Valley smelter. Thirteen tons of gold ore from the Gold Pen mine was shipped to Silver City for treatment at the Trimble amalgamation mill, and a small lot of lead ore was shipped from a mine prospect to a lead smelter.

Regent district (*Rawhide*).—The Happy Hooligan and Bald Hornet claims were worked, and some screened ore containing chiefly gold and silver was shipped to the Tonopah cyanidation plant. Some ore was treated by amalgamation in a local plant.

Santa Fe district.—Five lode mines in the Santa Fe district produced 317 tons of ore which yielded $582 in gold, 1,358 ounces of silver, and 29,130 pounds of copper, valued in all at $6,433, or $20.29 in metals a ton. Most of the output (280 tons) was copper ore shipped to the smelters at Thompson, Nev., and Tooele, Utah. The principal producers were the Champion Extension, Copper Queen, and Lime Point properties.

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[6] Nevada Mining Press, Feb. 14, 1930.

Silver Star (Marietta, Black Mountain, Gold Range, Douglas) district.—Seven lode mines in the Silver Star district produced 322 tons of ore yielding $8,607 in gold, 2,525 ounces of silver, 242 pounds of copper, and 12,567 pounds of lead, valued in all at $10,788, or $33.50 in metals a ton. Five lots of siliceous gold ore were shipped from the Mary Ann property, some of the ore going to the Mason Valley smelter and one lot to the Tonopah cyanidation plant. The Old Douglas mill was used for treating one small lot of gold recovered by amalgamation. The Kernick Divide Mining Co. shipped gold ore to cyanide mills near Tonopah, and the Silver Gulch Mining Co. sent lead ore to a Utah smelter.

Sodaville (Pilot Mountains) district.—The White Rock group or Telephone Canyon gold mine was operated under lease to the Pilot Gold Mines (Inc.). Siliceous gold and silver ore was sold to the copper smelter at Thompson.

Washington district.—Development work on the Jewett mine, 1½ miles west of East Walker River, resulted in the production of a little gold bullion from sorted ore treated by amalgamation.

NYE COUNTY

Bellehelen district.—Lessees working on the property of the Clifford Gold Mines Co. in the Bellehelen district shipped several lots of siliceous ore containing gold and silver to the cyanide mill near Tonopah. The old Longstreet mine, operated by the Golden Lion Milling & Mining Co., constructed a 100-ton cyanide mill and treated about 100 tons of ore before closing the property. Precipitates containing gold and silver were shipped to a smelter. Ore from the Old Age and Pacific States claims was shipped to Tonopah for treatment.

Bruner Section (Phonolite) district.—Some gold and silver mill cleanings were shipped to a smelter from the property of the Golden Eagle Mining & Milling Co.

Bullfrog district.—A short run of the Pioneer 10-stamp mill produced some gold bullion from ore taken out in development of the Pioneer mine. Near Carrara the Gold Ace Mining Co. was reported operating a 100-ton amalgamation mill on ore from the Bull Moose claims. The Bull Moose mine is developed by a 250-foot vertical shaft.

Fairplay district.—Test lots of ore, 22 tons in all, were shipped from claims in the Fairplay district to the Mason Valley smelter. From the Gold Dyke property some gold-silver ore went to a Utah smelter. Copper ore was shipped from the Hyslop property.

Fresno district.—A lessee shipped ore from the Clipper claims in Georges Canyon, 46 miles northeast of Tonopah, to a custom cyanide mill. The ore contained considerable silver and one-half ounce of gold to the ton and was taken out in development of the claims.

Hannapah district.—The Richardson group of claims 20 miles east of Tonopah in the Hannapah district produced 43 tons of gold and silver ore, part of which was shipped to a cyanide mill near Tonopah and two other lots containing gold and silver to the Mason Valley smelter and a smelter in Utah.

Johnnie district.—Gold and silver bullion was shipped from the Congress and Johnnie mines in the Johnnie district. The ore produced was treated in a 12-stamp amalgamation mill.

Manhattan district.—Eleven lode mines and seven placers in the Manhattan district produced 7,013 tons of ore, $118,750 in gold, and 402 ounces of silver, valued together at $118,964. The ore had an average value of $16.66 in metals a ton. A little over half the ore produced was shipped direct to the Mason Valley smelter and to smelters in Utah and California. Most of the smaller lots of ore produced in the district were treated by amalgamation in a custom mill at Manhattan. The placer output consisted of $2,088 in gold and 49 ounces of silver, valued together at $2,114. The White Caps Gold Mining Co. operated continuously during 1929 and was a regular shipper of ore, producing more than 4,000 tons containing over 1 ounce of gold to the ton. Some high-grade ore was opened on the 1,100 level of the White Caps mine and was said to carry mercury in addition to the gold. The mine has had a curious career, having produced antimony and arsenic at various times in the past. Ore was also produced from the Big Sam mining claim, the Jumping Jack, Last Chance, Mayflower, Midas, and Stray Dog. About 2,000 tons of ore was treated in the War Eagle mill, which was used as a custom plant by the Nevada Coalition Gold Mines Co. This company took an option on the Coop-Schubert property, from which most of the gold ore treated was mined. Important developments were reported in the property of the Manhattan Gold Mines Co., which produced ore containing free gold and averaging approximately $480 in gold to the ton.

Round Mountain district.—One placer and three lode mines in the Round Mountain district produced 6,358 tons of ore, $57,413 in gold, and 3,531 ounces of silver, valued together at $59,295. The ore had an average value of $4.13 in metals a ton. The output of metals was chiefly from the property of the Round Mountain Mines Co.; this company was reorganized in April and the name was changed to the Nevada Porphyry Gold Mines (Inc.). Two hydraulic giants operated on the surface property of the company, which depends on water from the Toyaibe and Toquina Mountain Ranges bordering Smokey Valley for its operation of hydraulic equipment. About 22,000 cubic yards of surface material was placered in 1929, and the amalgamation mill of 20 stamps was operated intermittently. The Gold Hill Development Co. developed the Gold Hill mine, 5 miles north of Round Mountain, and reported having found ore on the 400-foot level. Three thousand tons was put on the dump for subsequent treatment.

San Antone district.—The Hudson Mining & Milling Co. in the San Antone district was a producer of a little lead ore which was shipped to a lead smelter in California.

Silverbow district.—The Silverbow mine, 50 miles east of Tonopah, under development for the past two years, was recently equipped with a mill to treat 25 tons of ore a day. During a trial run of the mill some concentrates and gold bullion were produced, and one lot of silver ore was shipped to a custom cyanide plant.

Tolicha district.—About 40 tons of gold and silver ore was reported from the Tolicha district, probably from the Landmark group. The ore carried about $12 in gold to the ton and was treated by cyanidation.

Tonopah district.—Fourteen lode properties, one of which has workings in the Esmeralda County side of the Tonopah district, produced 121,447 tons of ore yielding $414,628 in gold and 1,965,595 ounces of silver, valued together at $1,462,291, or $12.04 in metals a ton. This output consisted of 121,359 tons of ore and old tailings treated by cyanidation and 88 tons of ore of smelting grade. The value of the output of this region decreased $64,428 compared with 1928. The total output of the district is given in the following table:

Mine production of gold, silver, copper, and lead in the Tonopah district, Esmeralda and Nye Counties, Nev., 1928 and 1929, and total, 1904–1929

Year	Mines producing	Ore	Gold	Silver	Copper	Lead	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	
1928	11	103,109	$415,035	1,900,315			$1,526,719
1929	14	121,447	414,628	1,965,595			1,462,291
Total, 1904–1929		8,114,497	34,964,382	159,706,562	12,175	214,523	136,978,553

The Tonopah Mining Co. ranked first in the production of silver in Nevada in 1929, followed by the Tonopah Extension Mining Co. The principal operations in the Tonopah district in 1929 were carried on by these two companies. The continued decline in the price of silver caused the Tonopah Belmont Development Co. to stop work on company account on August 3. Work was continued by lessees, most of whom were miners formerly employed by the company; by careful sorting they made a small profit from the ore sold. The Tonopah Mining Co. has operated its Tonopah mine almost continuously since 1902, but for the past 10 years its life has been very uncertain. The company's cyanidation plant at Millers, operated as a custom mill,[7] treated 66,051 dry tons of ore, of which 33,483 tons was from the Tonopah mine. The 33,483 tons of company ore yielded 6,765 ounces of gold and 684,584 ounces of silver. With silver selling at 40 cents an ounce the company could not operate at a profit, and on February 26, 1930, the board of directors ordered the mine closed indefinitely. The Tonopah Extension property was sold during March, 1929, by its receiver; after the first of April the mine and mill operated continuously under the management of the Tonopah Extension Mines (Inc.). Operations at the mine, both before and after the sale of the property, resulted in an output of 63,153 tons of ore, from which gold and silver bullion valued at $452,059 was produced by cyanidation. Most of the ore mined from the property in 1929 came from the western part of the district in Esmeralda County; lessees worked in the Nye County part of the property, shipping their ore to a custom mill. In 1929 the new company did 6,426 feet of new development work. The mine is opened by the Victor shaft, 2,000 feet deep, and the McKane shaft, 1,650 feet deep. No dividends were paid from 1926 to 1929; $3,927,221 in dividends was distributed from 1905 to 1925.

According to the Nevada State tax collector, the West End Consolidated produced 5,792 tons of ore, from which gold and silver valued at $103,900 were recovered at the custom cyanidation plant at Millers. The company is reported to have canceled all leases and suspended operations. Resumption of operations will depend upon the results of development work in the adjoining mines in the western part of the district.

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[7] Tonopah Mining Co. of Nevada Ann. Rept. for year ended Dec. 31, 1929.

Tybo district.—According to the annual report[8] of the Treadwell Yukon Co. (Ltd.), its flotation mill in the Tybo district was completed and began to operate on May 12. The ore treated to the end of the year amounted to 54,065 tons, assaying 0.02 ounce of gold and 8.45 ounces of silver to the ton, 5.15 per cent of lead, and 4.51 per cent of zinc. The mill performed in accordance with expectations for sulphide ores, but the milling of 11,761 tons of dump ore, 603 tons of old concentrates, and a portion of the mine ore that had become somewhat oxidized adversely affected the recovery of metal. The mill proved to have a capacity of 100 tons in excess of its estimated capacity of 250 tons a day. The lead-silver concentrates shipped to the Selby smelter in California amounted to 3,026 tons, averaging 0.178 ounce of gold and 91.24 ounces of silver to the ton, 62.86 per cent of lead, and 2.80 per cent of zinc. The zinc concentrates, of which 2,999 tons was shipped, went to the Sullivan electrolytic zinc plant at Silver King, Idaho. The zinc concentrates assayed 0.037 ounce of gold and 13.55 ounces of silver to the ton, 4.1 per cent of lead, and 46.54 per cent of zinc. Ore reserves at the end of the year were estimated at 230,000 tons, assaying 0.02 ounce of gold and 10 ounces of silver to the ton, 6 per cent of lead, and 5 per cent of zinc. During 1929 the mine was opened by 2,358 feet of new development work. It has two vertical shafts, one 710 feet deep and the other 976 feet deep. The 350-ton flotation mill has a Blake and a Symons cone crusher, 2 Hardinge ball mills, 2 Dorr classifiers, 32 Minerals Separation cells (half for lead circuit and half for zinc circuit), 2 Oliver filters, and 3 Hardinge thickeners. A recent article by Hales[9] on the lead-zinc ore treatment at the Tybo mill is of interest.

Union district.—During 1929 the Shamrock mine near Ione in the Union district was operated under lease. A cyanidation plant was constructed in 1924 but was never operated; changes were recently made for table concentration. A trial test of 17 tons of ore yielded concentrates containing 8 ounces of gold and 74 ounces of silver to the ton. The concentrates with crude ore assaying 174 ounces of silver a ton were shipped to a smelter. Some gold and silver recovered by amalgamation were sent to the mint.

ORMSBY COUNTY

Carson River district.—During 1929 the old tailings on the Morgan mill site were worked over by a lessee and yielded some gold bullion.

Delaware (Sullivan) district.—Interest in the Delaware district was revived by the shipment of copper ore from the Bessemer property to a smelter in Utah.

PERSHING COUNTY

Antelope district.—Development work in the Majuba Hill mine in the Antelope district resulted in the shipment of 94 tons of copper ore containing a little silver. The property is in Meachen Canyon, 18 miles west of Imlay. Lessees shipped about 20 tons of lead-silver ore from the Nevada Superior property to a smelter in Utah.

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[8] Treadwell Yukon Co. (Ltd.) Ann. Rept. for year ended Dec. 31, 1929.

[9] Hales, W. E., The Tybo Mill: Min. Cong. Jour., vol. 15, December, 1929, pp. 961-964.

Arabia district (*Oreana*).—Lessees shipped 46 tons of antimonial lead-silver ore from the Electric Mining & Reduction Co. claims in the Arabia district.

Echo district.—The Chipmunk and Packers Dream claims in Echo Canyon were under development and lead-silver ore containing gold was shipped to a smelter in California.

Haystack district.—The Lone Star claim, 10 miles from Jungo in the Haystack district, produced one car lot of ore containing an ounce of gold to the ton but no silver.

Jersey Valley district.—Lessees opening up the Rex claims in the Jersey Valley district shipped some lead-silver ore during 1929. The property is extensively developed by a shaft 500 feet deep and by 3,000 feet of tunneling.

Placerites (*Rabbit Hole*) *district.*—The Associated Royalty Co. leased its surface area of volcanic material to operators who worked with pick, shovel, and scrapers and recovered some gold (896 fine) with a rocker. The Placerites district is about 7 miles south of Sulphur on the Western Pacific Railroad. According to a personal communication from J. T. Reid of Lovelock to the author, the district was discovered in the fifties but was not worked at that time on account of lack of water. Placer operations were carried on in the nineties, first by carting the gravel to a spring and later by bringing in a ditch from Cow Canyon.

Rochester district.—Six operators of lode mines in the Rochester district produced 4,479 tons of ore and old tailings yielding $7,992 in gold, 52,628 ounces of silver, and 1,670 pounds of copper, valued in all at $36,337, or $8.11 in metals a ton. Most of the ore produced was treated by lessees in the mill of the Rochester Silver Corporation. As the company was in process of liquidation owing to the low price of silver, the mine and the mill were closed. Operations ceased in February and the mill equipment was advertised for sale.

Rosebud district.—The Jane claim, formerly the Brown Palace, continued to be a producer of gold-silver ore which was shipped to a smelter.

Seven Troughs district.—Although considerable development was in progress in the Seven Troughs district, no ore was treated and no production was recorded. Late in 1929 the Seven Troughs Gold Mines Co. started constructing a 100-ton cyanidation plant to reduce the gold ore recently developed in the lower levels of the mine, which is opened by a tunnel 7,492 feet long. Additional development amounted to 1,540 feet of drifts, 300 feet of raises, and 1,384 feet of crosscuts. The new mill is expected to be in operation in July, 1930; its equipment is ready to be delivered and consists of a Telsmith 8A gyratory crusher, 2 Hardinge ball mills, 2 Dorr classifiers, 1 Oliver filter, 4 Dorr agitators, and 4 Dorr thickeners.

Sierra district.—At Natchez Pass, 12 miles southeast of Mill City, the stamp mill on the Last Chance group was operated and gold bullion was produced. At the Silver Pick property about 3 tons of silver ore was mined and shipped to a smelter.

Spring Valley district.—In the Spring Valley district placer gold from small operations was produced in 1929.

Unionville district.—At the Congo mine, which was worked by a lessee, 39 tons of 5 per cent copper ore was shipped to a smelter in Utah.

STOREY COUNTY

Comstock district.—Twelve producers in the Comstock district reported 11,244 tons of ore and old tailings yielding $109,879 in gold, 32,399 ounces of silver, and 2,611 pounds of copper, valued in all at $127,608, or $11.35 in metals a ton. Half the ore reported was from the Lady Bryan and Berry property, an important producer operated by the Flowery Mines Co. Dividends amounting to $30,750, including $15,750 paid in 1929, have been disbursed. The 200-ton cyanide plant for the reduction of ore was operated only six months; both mine and mill were closed in December. For some time the mill has been operated at a profit on ore carrying less than $3 in gold and silver; this is one of the most remarkable mining records for a low-grade proposition in Nevada. Ore from the Silver Hill mine was treated in a 10-stamp amalgamation and cyanide plant. The mine is opened by a 220-foot inclined shaft and 500 feet of drifts. An important addition was made to the metal output by the Sutro Tunnel & Development Co., which produced ore from its Crown Point ore body during development work. In addition to this development the company also opened up promising areas in the Chollar, Potosi, and other old properties. Other producers of ore in the Comstock district were the Arrowhead, Comstock Silver, Midas, and Prospect properties. Of interest was the activity at the Keyes mine on the Brunswick lode, about 2 miles east of Virginia City. About 20 years ago a wide vein of quartz was prospected on the 300 level and the property was closed. Recently, the Belmont Uncle Sam Mining Co. sunk a winze 35 feet and opened 4 feet of high-grade ore. The mine was last operated by the Mexican Silver Mining Co.

WASHOE COUNTY

Cottonwood district.—The Ambassador Mines Co. developed its property in the Cottonwood district and shipped to a smelter 3 tons of 25 per cent lead ore carrying silver and a little gold.

Donnelly district (*Gerlach*).—Some gold ore was mined by three producers in the Donnelly district, which is near the Humboldt County line and 6 miles east of the Leadville district on Division Peak. The ore produced was closely sorted and was treated in hand mortars. One lot was shipped direct to the Selby (Calif.) smelter.

Peavine district.—Twenty-two tons of oxidized sulphide copper ore from surface deposits and from the Gold Bond claim in the Peavine district was shipped to a smelter in Utah.

Pyramid district.—The Blue Bird mine in the Pyramid district produced during development work sulphide ore averaging 8.25 per cent of copper, and 9.6 ounces of silver and 0.03 ounce of gold to the ton.

Washoe district.—The Ford Silver-Lead Mines (Inc.), operating a property in the Washoe district, shipped sulphide ore containing lead, silver, and a little gold.

White Horse district.—Five producers in the White Horse district reported an output of 160 tons of ore yielding $1,314 in gold and 30 ounces of silver, valued together at $1,330, or $8.31 in metals a ton.

Most of the output was treated by amalgamation in a local crushing plant; one small lot was shipped to a smelter. The Green Hill, Renegade, Springfield-Nevada, and White Horse mines were worked by lessees, and each produced some ore.

WHITE PINE COUNTY

Aurum or Silver Mountain district (*Schellbourne*).—Four lode mines in the Aurum district produced lead ore and copper ore during development work. The Inland Lead Co. shipped some lead ore from its property, which is opened by an inclined shaft 90 feet deep and a tunnel 75 feet long, with 140 feet of drifting. The ore is hauled 30 miles to Ray, the railroad siding on the Nevada Northern Railway. Copper ore was shipped from the Cambrian Copper property and from the Nevada Homestake.

Bald Mountain district.—The Brandt Mining Co., operating the Peace mine, shipped oxidized copper ore containing silver and gold to a smelter in 1929. This mine is opened by a tunnel 630 feet long and has a vertical shaft 100 feet deep. The ore mined during development of the property was hauled to Elko, 75 miles north of the mine.

Cherry Creek district.—Lead ore and siliceous gold ore were produced from the Nevada Standard property, which includes the Mary Ann, Star, and Exchequer claims. The company reconstructed the old 20-stamp mill and added Wilfley tables, ball mill, and flotation cells. No ore was treated in the mill in 1929, but 109 tons mined in development of the property and shipped to a smelter contained more than an ounce of gold and 20 ounces of silver to the ton, and a little lead and copper. The Wide West in Gold Canyon was also a producer of siliceous gold ore containing a little silver and copper.

Duck Creek district.—Five lode mines in the Duck Creek district produced 92 tons of ore yielding $62 in gold, 767 ounces of silver, and 97,419 pounds of lead, valued in all at $6,608, or $71.83 in metals a ton. Lessees operating the property of the McGill Mining Co. produced 38 tons of sulphide lead ore yielding 114 ounces of silver and 39,138 pounds of lead. Other mines from which lessees reported small shipments of lead ore were the Carbonate Lead, Galena, Look Out, and Success.

Hunter district.—The Hunter claims, 22 miles southwest of Cherry Creek post office, were under development by a lessee who shipped 31 tons of copper-lead ore containing silver and gold.

Osceola district.—During development of the Woodman mine the Nicholson Mining & Milling Co. treated 38 tons of free gold ore in an amalgamation mill and reported bullion amounting to $2,195 in gold and silver. The gravel from the Osceola drift placer was worked by dry washing. About 10 ounces of gold was recovered between April and October.

Piermont district.—The Piermont Mines Co. completed construction of a milling plant with flotation equipment September 23 and operated on siliceous silver ore containing some silver sulphides and a little gold. The concentrates shipped to a smelter in Utah averaged 1.3 ounces of gold and 637 ounces of silver to the ton. The mine is opened by two tunnels 3,000 feet and 1,500 feet long and three inclined shafts, the deepest of which is 1,000 feet.

Robinson district (*Ely*).—The five lode mines operating in the Robinson district in 1929 increased their output of ore. Most of the ore came from the Nevada Consolidated mine and was chiefly of milling grade. The district was the largest producer of gold and copper in Nevada in 1929. The general increase in the output of the district is indicated in the following table:

Mine production of gold, silver, copper, lead, and zinc in the Robinson district, White Pine County, Nev., 1928 and 1929, and total, 1904–1929

Year	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1928	11	5, 730, 471	$1, 442, 902	233, 944	141, 969, 162	406, 188	----------	$22, 046, 877
1929	5	6, 378, 138	1, 321, 640	204, 108	130, 754, 962	71, 094	----------	24, 447, 782
Total, 1904–1929	-------	70, 148, 605	12, 823, 871	2, 200, 937	1, 559, 485, 259	4, 951, 723	6, 070, 025	276, 102, 995

The Nevada Consolidated Copper Co.[10] operated its mines and reduction works in the Robinson district continuously during 1929 and milled at McGill 5,220,987 dry tons of ore from the steam-shovel pit and underground workings and 1,033,042 dry tons of custom ore, a total of 6,254,029 tons concentrated (an average of 17,134 tons a day), with a milling cost averaging 42.1 cents a ton. The flotation concentrates produced were smelted with crude ore from the company's mines and ore received from the adjoining property. The production of metal is not given separately by the company but is combined with that of the Ray Consolidated Copper Co. at Ray, Ariz., and the Chino mine at Santa Rita, N. Mex. At its mine in Nevada the Monitor shaft was sunk 630 feet to a point 70 feet below the B level, the upper 280 feet of the shaft was concreted, and the Wedge shaft workings were connected on both A and B levels. At the Ruth mine about 75 per cent of the necessary haulage ways on the ninth level were completed. The following paragraphs are from the company's annual report:

> At Nevada Mines the new 7,500 KW. turbo-generator, complete with auxiliary equipment, was installed during the year and other minor improvements and betterments were also effected at the McGill power plant, which is now provided with adequate capacity to meet the requirements of full tonnage operations. The replacement of the old wooden pipe line which carried water from the Duck Creek reservoir to the reduction works at McGill with a steel line was completed during the year, and in the Duck Creek Basin itself many of the old conduits previously placed in the stream channels leading to the reservoir were replaced with larger lines. Much of this old piping had rusted through and portions of it were inadequate to carry the maximum flow of water. As a result of this work the amount of available water has been substantially increased and is now sufficient, in normal seasons, to permit the continued operation of the concentrator at its full present capacity of 18,000 tons a day. At the mines six secondhand 80-ton locomotives and fifty new 80-ton ore cars were purchased to provide adequate equipment for pit and ore transportation operations. The Murry Springs pipe line was placed in service and an ample supply of water for domestic requirements thus secured. At both the McGill and Ruth plants facilities were provided during the year for more adequate and better housing and recreational advantages for employees and their families.

A recent article by Young[11] describing the surface equipment of the Nevada Consolidated mines states the entire production to the end of June, 1929, aggregated about 58,000,000 tons of ore from the open-pit and underground operations. Stripping operations by steam shovel amounted to about 44,145,000 cubic yards for the same period.

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[10] Nevada Consolidated Copper Co. Ann. Rept. for year ended Dec. 31, 1929.

[11] Young, George J., Maintenance at Nevada Consolidated's Nevada Mines: Eng. and Min. Jour., vol. 129, Mar. 8, 1930, pp. 227–232.

The Nevada Northern standard-gage railroad connects the producing mines with McGill, 26 miles away, to which the ore is conveyed for milling and smelting. Here the ore is milled and the concentrates with crude ore are smelted. Blister copper is produced and shipped to eastern refiners.

The Consolidated Coppermines Corporation shipped ore from the Morris-Brooks, Emma Nevada, Richard, and Old Glory mines during 1929 and, according to the printed annual report, mined 1,071,196 dry tons of ore, compared with 961,487 tons in 1928. All the ore of milling grade was concentrated at the Nevada Consolidated flotation plant at McGill. Besides the low-grade copper ore, the chief product, first-class copper ore of good grade was shipped to the smelter at McGill and lead ore from a lessee's operation was shipped to Utah for smelting. The copper ore of both milling and shipping grade (1,071,196 tons) yielded 22,731,703 pounds of copper, 11,950.22 ounces of gold, and 30,159 ounces of silver. Development, particularly by churn drilling, has increased the ore reserves of the company, and these conditions are reviewed in the company's printed annual report for 1929, part of which follows:

> Development work and active mining were carried on in the Morris-Brooks mines during 1929. * * * Production amounted to 671,907 tons averaging 1.13 per cent copper.
>
> Active drawing of ores from the 6,660 level of the Emma Nevada mine commenced in July, and production for the year amounted to 320,290 dry tons averaging 1.08 per cent copper.
>
> Development work on the 6,660 level consisted in completing the service drifts near the shaft and extending the extraction drifts under the ore body. The ground encountered in most parts of the workings on this level is excellent and as the workings are located a considerable distance from the scene of the heavy blasting in the Nevada Consolidated pit, no difficulties have been experienced in the maintaining of the drifts. Development on both levels is now advanced sufficiently so that greatly increased production through the shaft can be maintained.
>
> Production of the Richard mine amounted to 13,810 tons averaging 4.25 per cent copper, all produced during the last few months of the year. Prospecting was carried on with diamond drills and extensions to the south and southwest of the partly developed ore bodies were definitely proven.
>
> The Alpha mine shaft has been completely retimbered to the 1,000 level and the entire shaft is in first-class condition to the bottom or 1,841 feet below the collar. The shaft has been concreted for a height of 192 feet in the portion where the ground was badly fractured and caved.
>
> The unwatering of the mine was successfully completed, the quantity of water handled during the unwatering period amounting to approximately 160,000,000 gallons. Permanent pumps of sufficient capacity and reserve pumps have been installed on the 1,200 and 1,400 levels, the flow of water at present amounting to 900 gallons per minute and coming mainly from the 1,400 level.
>
> The major portion of the old workings on the 1,200 and 1,300 levels has been reopened and the old stopes prepared for production. Prospecting easterly and westerly beyond the previously known ore zone has developed new and valuable ore bodies on the 1,000 level. This development materially extends the area favorable to ore deposition and it is particularly encouraging to note that the best stope ever opened up in the Alpha is located in this recently developed extension to the west.
>
> Shaft pockets have been installed on the 1,300 and the 1,800 levels. On the last mentioned level arrangements are being made for a sump, and drifts have been started towards the ore zone.
>
> Ores are being produced from the 1,000, 1,200, and 1,300 levels and production during the last few months of this year has amounted to 13,008 dry tons averaging 5.37 per cent copper.

The Old Glory mine has been opened up from a drift on the 360 level of the Morris-Brooks mine. Sulphide ores of good grade were encountered in fracture zones in the sedimentary footwall north of the porphyry. Production of ores commenced in August and has amounted to 13,689 tons at an average grade of 4.84 per cent copper.

Production for the three months of 1930 has amounted to approximately 9,900,000 pounds of copper. Since the middle of February the Emma Nevada mine has supplied all the concentrating ores that have been shipped under the contract, resulting in an increasing grade of the ores produced and a reduction in operating costs.

The churn drilling and development have definitely proven a present reserve of porphyry ores of this date amounting to over 30,000,000 tons. By making proper allowance for dilution with overlying low grade or barren material, which might occur when the ores are mined, it is estimated that the average grade of these ores as sent to the concentrator will be better than 1.1 per cent copper. The recently found ore bodies show a tonnage in excess of 11,000,000 tons with an average grade of 1.3 per cent copper. The net present value of this newly discovered ore on a fifteen cent copper market is in excess of ten million dollars. The underlying primary ores show a considerably higher copper content; individual 5-foot samples having shown as high a grade as 4.4 per cent copper. The above-mentioned average grade of 1.3 has been arrived at by including overlying lower grade primary and secondary ores that can be mined at a profit. Drilling continues and further additions to existing ore reserves can confidently be expected in this area and in other areas favorable for ore deposition. * * *

Copper ore was produced from the Los Angeles property, owned by the Boston & Ely Mining Co. which also owns the Smoky group, operated under lease and bond in 1929. A car lot of silver-lead ore was shipped from the Silver Age mine to a smelter in Utah.

Snake (*Bonita*) *district.*—Seven tons of lead ore were shipped from the Poljack claim in Youngs Canyon, Snake district.

White Pine district (*Hamilton*).—Eight lode mines in the White Pine district produced 4,479 tons of ore and old tailings yielding $1,045 in gold, 13,263 ounces of silver, 1,068 pounds of copper, and 286,026 pounds of lead, valued in all at $26,322, or $5.88 in metals a ton. Considerable high-grade lead-silver ore was developed in the Nevada Lead property by the Tonopah Belmont Development Co., which milled the lower grade ore in a 50-ton concentration mill equipped with jigs and tables. The plant operated during three months of 1929, and operations were suspended at the end of the year due to the low price of silver and lead. Other mines and claims producing ore were the Grand Prize, Peterson, and Young Treasure. The old tailings were principally from the old Smoky mill and the Richland property.

ZINC [1]

By Elmer W. Pehrson [2]

GENERAL SUMMARY

Salient figures of the zinc industry in the United States, 1928 and 1929

	1928	1929
Production of primary zinc:		
From domestic ores...short tons	591, 525	612, 136
From foreign ores...do	11, 056	13, 311
	602, 581	625, 447
Apparent deliveries of primary zinc to domestic consumers...do	578, 060	568, 525
Estimated industrial use of primary and secondary slab zinc...do	626, 500	628, 300
Stocks of zinc on hand at smelters Dec. 31...do	48, 432	85, 904
Ratio of electrolytic zinc to total primary zinc production...per cent	26. 58	24. 98
Recovery of unalloyed secondary zinc...short tons	70, 700	65, 400
Prices per pound of prime western zinc at St. Louis:		
Average for year...cents	6. 03	6. 49
Highest monthly average...do	6. 35	6. 78
Lowest monthly average...do	5. 55	5. 65
Mine production of recoverable zinc...short tons	695, 170	724, 478
Tri-State district (Joplin region)...per cent of total	43	43
Western States...do	33	33
Other...do	24	24
World smelter production of zinc...short tons	1, 559, 000	1, 613, 000

Conditions in the United States zinc industry during the first half of 1929 were satisfactory. During the latter half, however, a sharp decline in consumption, with which producers failed to keep pace, resulted in a rapid increase in stocks and finally in a very marked price cut after the stock-market crash in October. The production of primary zinc during 1929 was the largest since the war and the consumption of primary and secondary slab zinc exceeded all previous records, but the net increase of 77 per cent in producers' stocks and the net decrease of 14 per cent in the St. Louis price of zinc left the industry in a very weak position at the end of the year.

The price of zinc, although lower at the end of the year than at the beginning, averaged 6.49 cents per pound at St. Louis as compared with 6.03 cents in 1928. The opening quotation was 6.35 cents, and by April 1 it had increased to 6.80 cents due largely to increased consumption. In April and May the trend was downward, but it turned upward again in June and from July to October the quotation was well maintained at an average of over 6.7 cents, notwithstanding a substantial decrease in consumption and a rapid increase in stocks.

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[1] Work on manuscript completed November, 1930.

[2] The statistics in this report were prepared (unless otherwise indicated) by H. M. Meyer, and the data on imports and exports were compiled from records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, both of the Bureau of Mines.

After the stock-market crash the price declined to 5.45 cents at the close of the year.

The production of primary zinc in the United States amounted to 625,447 tons as compared to 602,581 tons in 1928, production from domestic ores having increased 3.5 per cent and from foreign ores 20.4 per cent. In 1929 electrolytic zinc amounted to 25.0 per cent of the total primary output, as compared to 26.6 per cent in 1928. The decrease was due to curtailment in Montana. The recovery of unalloyed secondary zinc decreased 7.5 per cent.

Although there was a slight decrease in the apparent deliveries of primary zinc to domestic consumers the industrial use of primary and secondary zinc exceeded all previous records. The substantial increases in the quantity of zinc used in brass making and die casting more than offset the decreases in rolled zinc and other uses.

Mine production increased 4 per cent in 1929. The principal increases were in Idaho, Oklahoma, Tennessee, Virginia, Nevada, and Utah, while Montana, Colorado, and Missouri showed substantial decreases. Production in the tri-State area, in the Western States, and in the Southern and Eastern States was in the same ratio to the total production of the country as in 1928.

World smelter production in 1929 exceeded all previous records, having increased 3 per cent over 1928. The principal increases were in the United States, Poland, Italy, Canada, Japan, Mexico, Great Britain, Czechoslovakia and Northern Rhodesia, while there were relatively small decreases in Belgium, France, and Spain.

Considerable progress was made toward production of zinc at the Flin Flon and Sherritt-Gordon properties in Manitoba and the Errington mine in Ontario. The Mount Isa project in Queensland, Australia, was being equipped for immediate lead production, and the production of zinc concentrates is expected within a few years. The installation of additional plant capacity at the Sullivan mine, British Columbia, was nearly complete at the end of the year, and plans were made for doubling the output of the Buchans mine in Newfoundland. The Cerro de Pasco Copper Corporation will increase its output of zinc and lead ores in Peru. The outstanding new development in 1929 was the Stantrg mine in Yugoslavia, where nearly 2,000,000 tons of ore which averages 11.5 per cent lead, 10.5 per cent zinc, and 3 ounces of silver has been developed. Production at a rate of 500 tons of ore daily was expected in 1930. Other properties are being prospected, which may lead to increased reserves in Yugoslavia.

Producers at Broken Hill, New South Wales, were concerned about the expiration of the contract with the British Board of Trade under which they had disposed of their zinc concentrates since the war at a price considerably above the open market. The situation was intensified by the steady decline of metal prices during 1930 and the wage agreement they were forced to operate under until October, 1930. Up to September, 1930, some of the smaller mines had shut down completely, and two of the larger producers had discontinued the production of zinc concentrates.

The London price of zinc declined steadily after March and in December reached the lowest level recorded in 21 years. The curtailment program of the European Zinc Cartel proved to be ineffective in stabilizing the industry, and in November it was decided to discontinue the agreement at the end of the year. A committee was appointed to prepare plans for a new cartel which would include a larger share of the world's zinc production; although many conferences were held no positive results had been announced by November 1, 1930.

PRODUCTION

GENERAL

The production of slab zinc is classified by the Bureau of Mines as (1) primary or secondary, according to whether the zinc has been manufactured from primary or secondary materials; (2) domestic or foreign, a division of primary production based on whether the materials used were domestic or foreign; (3) electrolytic or distilled based on the process of manufacture.

To determine the production of primary zinc, the Bureau of Mines makes a canvass of the zinc smelters that ordinarily operate on primary raw materials of domestic and foreign origin. Many of these smelters also include substantial amounts of secondary materials in their furnace charges, so the slab zinc produced includes both primary and secondary zinc. Although the two are inseparable, the smelter calculates the amount of zinc produced from the secondary materials and classifies it as redistilled secondary zinc. A similiar calculation is made in order to separate primary zinc into zinc of domestic and foreign origin.

The following table shows the quantity and value of domestic primary, foreign primary, and redistilled secondary zinc produced in the United States during the last 10 years.

Distilled and electrolytic zinc produced in the United States, 1920–1929

Year	Domestic primary		Foreign primary		Redistilled secondary		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1920	450,045	$72,907,000	13,332	$2,160,000	21,371	$3,462,000	484,748	$78,529,000
1921	198,232	19,823,000	2,268	227,000	17,573	1,757,000	218,073	21,807,000
1922	353,274	40,273,000	1,003	114,000	32,988	3,761,000	387,265	44,148,000
1923	508,335	69,134,000	2,099	285,000	39,434	5,363,000	549,868	74,782,000
1924	515,831	67,058,000	1,508	196,000	35,486	4,613,000	552,825	71,867,000
1925	555,631	84,456,000	17,315	2,632,000	39,181	5,955,000	612,127	93,043,000
1926	611,991	91,799,000	6,431	964,000	40,799	6,120,000	659,221	98,883,000
1927	576,960	73,851,000	15,556	1,991,000	42,784	5,476,000	635,300	81,318,000
1928	591,525	72,166,000	11,056	1,349,000	48,666	5,937,000	651,247	79,452,000
1929	612,136	80,802,000	13,311	1,757,000	47,348	6,250,000	672,795	88,809,000

PRIMARY ZINC

The term "primary zinc," as used herein, refers only to zinc produced from ores or from the immediate by-products of primary reduction operations. Thus, zinc manufactured from smelter drosses and skimmings is designated as primary, whereas that produced from galvanizers' drosses, ashes, and scrap metal is designated as secondary. Although a large part of the latter enters the market indistinguishable from the former and becomes part of the supply of zinc available to consumers, it is nevertheless deemed advisable to retain the above classification; otherwise the long-time record of production might include metal that is constantly reworked.

The following table shows the primary zinc produced in the United States from 1920 to 1929, apportioned according to the source of the ore and the locality at which it was reduced.

Primary zinc produced in the United States, 1920–1929, in short tons

APPORTIONED ACCORDING TO SOURCE OF ORE

Year	Domestic[1]	Foreign					Total
		Australia	Canada	Mexico	South America	Total	
1920	450,045	2,235	1,583	8,978	536	13,332	463,377
1921	198,232	133	521	1,614		2,268	200,500
1922	353,274		55	948		1,003	354,277
1923	508,335			2,099		2,099	510,434
1924	515,831		1,396	112		1,508	517,339
1925	555,631		7,997	9,318		17,315	572,946
1926	611,991			6,431		6,431	618,422
1927	576,960			15,556		15,556	592,516
1928	591,525			11,056		11,056	602,581
1929	612,136			13,311		13,311	625,447

APPORTIONED ACCORDING TO LOCALITY AT WHICH REDUCED

Year	Arkansas	Idaho	Illinois	Kansas	Montana	Oklahoma	Pennsylvania	Other States	Total
1920	31,481		109,056	41,044	50,017	110,500	74,234	47,045	463,377
1921	15,278		48,865	16,573	11,559	41,244	36,378	30,603	200,500
1922	13,627		76,266	24,167	55,369	74,537	57,319	52,992	354,277
1923	29,870		93,239	32,006	71,088	119,744	82,003	82,484	510,434
1924	28,447		93,370	28,640	77,493	118,487	83,016	87,886	517,339
1925	27,145		109,672	25,765	79.004	138,906	99,899	92,555	572,946
1926	32,712		110,381	33,671	111,596	136,560	100,538	92,964	618,422
1927	26,317		102,768	33,144	112,629	120,801	106,099	90,758	592,516
1928	20,505	1,939	103,765	33,923	158,221	106,557	108,802	68,869	602,581
1929	17,923	16,582	112,425	37,795	138,019	111,683	108,167	82,853	625,447

[1] The slab zinc that was rolled is included here.

The production of primary zinc in the United States in 1929 increased 22,866 tons or 3.8 per cent over 1928, the result of increases of 20,611 tons or 3.5 per cent in production from domestic ore and 2,255 tons or 20.4 per cent in production from foreign ores. In 1929, as in 1926, 1927, and 1928, all the foreign ore smelted in the United States was imported from Mexico.

Montana continued to be the leading producer of metallic zinc in 1929, even though the output was nearly 13 per cent less than in 1928. Illinois was second, with an 8 per cent increase which may be ascribed partly to the output of the new electrolytic zinc plant of the Evans-Wallower Zinc Co. at East St. Louis. Oklahoma, which for several years prior to 1928 ranked first, ranked third in 1929, notwithstanding a 5 per cent increase in output. Pennsylvania's output decreased slightly in 1929; that of Kansas increased about 11 per cent. Idaho's production increased to eight and one-half times the 1928 figure in consequence of increased output at the electrolytic zinc plant of the Sullivan Mining Co. at Kellogg. The production in Arkansas decreased 13 per cent in 1929. Other States in which zinc-smelting plants were operated in 1929 were West Virginia, Texas, and Indiana.

The production of primary zinc by the retort process increased 6 per cent in 1929; that by the electrolytic process decreased 2.5 per cent, notwithstanding increases in Illinois and Idaho. This is the first decrease in the yearly output of electrolytic zinc since 1921.

DISTILLED AND ELECTROLYTIC ZINC

As already stated, a considerable quantity of material designated as secondary zinc results from redistillation of zinc ashes and scrap; some smelters that handle ore regularly may at times smelt a mixture of secondary material and ore. Slab zinc so produced is not distinguished from primary metal when marketed. For statistical purposes, however, the amount of this secondary metal is calculated by the smelters and is recorded herein as redistilled secondary zinc.

Slab zinc produced for market is graded according to its purity. The official classification, as given by the American Society for Testing Materials, is shown below. The specifications of the United States Navy and War Departments are practically the same as those of the American Society for Testing Materials. Commercially, however, zinc is graded to narrower limits, and many companies market several varieties within the range of one official classification.

Classification of various grades of zinc and the maximum impurities allowed

Maximum impurities	Navy and War Departments				
	Grade A	Grade B	Grade C	Grade D	Grade E
	American Society for Testing Materials				
	High grade	Intermediate	Brass special	Selected	Prime western
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Lead	0.07	0.20	0.60	0.80	1.60
Iron	.03	.03	.03	.04	.08
Cadmium	.07	.50	.50	.75	(1)
Aluminum	None.	None.	None.	None.	(1)
Total	.10	.50	1.00	1.25	(1)

[1] Not specified.

In segregating production into the various grades the smelters report the total production and do not differentiate between primary distilled and redistilled secondary. The following table shows the total production of electrolytic and distilled zinc, both primary and secondary, apportioned according to method of reduction and according to grade.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1920–1929, in short tons

APPORTIONED ACCORDING TO METHOD OF REDUCTION

Year	Electrolytic	Distilled primary	Redistilled secondary [1]	Total
1920	51,626	411,751	21,371	484,748
1921	11,559	188,941	17,573	218,073
1922	55,369	298,908	32,988	387,265
1923	71,088	439,346	39,434	549,868
1924	77,493	439,846	35,486	552,825
1925	79,004	493,942	39,181	612,127
1926	111,596	506,826	40,799	659,221
1927	112,629	479,887	42,784	635,300
1928	160,160	442,421	48,666	651,247
1929	156,235	469,212	47,348	672,795

[1] For total production of secondary zinc see p. 685.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1920–1929, in short tons—Continued

APPORTIONED ACCORDING TO GRADE

Year	Grade A (high grade)	Grade B (intermediate)	Grade C (brass special)	Grade D (selected)	Grade E (prime western)	Total
1920	80,713	33,893	59,811		310,331	484,748
1921	24,084	4,996	47,814		141,179	218,073
1922	67,459	36,402	49,980		233,424	387,265
1923	89,739	58,513	90,459		311,157	549,868
1924	108,238	48,874	100,290		295,423	552,825
1925	111,964	49,198	81,176		369,789	612,127
1926	143,224	48,169	84,689		383,139	659,221
1927	150,933	40,121	72,104		372,142	635,300
1928	197,675	41,779	73,957		337,836	651,247
1929	207,321	27,430	96,163		341,881	672,795

This table shows a decrease of 2.5 per cent in electrolytic zinc production in 1929, compared with an increase of 42.2 per cent in 1928. In 1929 there was an increase of 6 per cent in production of primary distilled zinc, compared with a decrease in 1928. Recovery of redistilled secondary zinc decreased about 3 per cent in 1929. Production of all grades of zinc increased in 1929 except the "intermediate," which decreased more than 34 per cent.

HIGH GRADE

The production of high-grade metal, formerly used chiefly in the manufacture of die-casting alloys and special brasses, has so expanded as a result of the increased application of the electrolytic process that the supply far exceeds ordinary demands, and much of it is now being used in the manufacture of ordinary brass. The result has been a reduction in the premium paid for high-grade zinc. In 1914, when no electrolytic zinc was produced, the production of high-grade metal amounted to 5 per cent of the total output, and a premium of 3 cents a pound was paid. During the World War the premium increased to several times that amount, but in recent years it has decreased steadily. In 1929, 31 per cent of the total zinc produced was high grade and, according to the prices quoted by the American Metal Market, the premium fluctuated between 1.4 cents and 0.9 cent per pound, averaging 1.0 cent for the year.

INTERMEDIATE

The intermediate grade of zinc is practically all used in the manufacture of specialty alloys and brasses and is becoming less important. In 1923 nearly 59,000 tons were produced, but in 1929 production decreased to 27,430 tons. This grade of zinc commands a premium of about one-half cent a pound over prime western.

BRASS SPECIAL

Brass special, as its name suggests, is used largely in the manufacture of brass. The production of this grade of zinc, including a small tonnage of selected grade, decreased from 100,000 tons in 1924 to 74,000 tons in 1928 but increased to 96,000 tons in 1929. This increase was due to the fact that some producers who were forced to discontinue the production of intermediate zinc due to changed market conditions began producing brass special largely. The output of brass special was equivalent to 65 per cent of the total zinc used in the manufacture of brass in 1924 and 53 per cent in 1929. The premium on brass special in 1929 ranged from 0.10 to 0.21 and averaged 0.11 cent per pound over prime western.

SELECTED

Only a relatively small quantity of the selected grade of zinc is produced, and the tonnage is included with the production of brass special. It is used chiefly in the manufacture of cheaper brasses where uniformity of composition is necessary, such as in brass rod stock for machine-made screws, bolts, tire valves, etc. The narrower limits of composition of this grade of zinc permit a closer control on the machining properties of the brass product than could be obtained with prime western zinc. The premium on this grade is about 5 cents per 100 pounds.

PRIME WESTERN

Prime western zinc is the most common grade and is the principal product of retort smelters. In 1925 this grade amounted to 60 per cent of the total output but in 1929 had decreased to 51 per cent. It is estimated that approximately three-fourths of the production of this grade of zinc is used in the zinc-coating (galvanizing) industry. Prime western zinc is also used in the manufacture of cheaper grades of brass.

ROLLED ZINC

The accompanying tables show the quantity and value of rolled zinc produced in the United States from 1920 to 1929. The total production in 1929 amounted to 68,334 tons or 7 per cent less than the output in 1928 and 21 per cent less than that in 1926. The largest part of the decrease during the last three years may be attributed to the decline in the manufacture of dry cells that has resulted from the widespread adoption of "socket-power" radio receivers. According to the American Bureau of Metal Statistics the consumption of rolled zinc in the manufacture of dry batteries decreased from 28,350 tons in 1926 to 15,470 tons in 1929, a drop of 45 per cent. The total value of the rolled zinc produced was 2 per cent less in 1929 than in 1928 and 32 per cent less than in 1926.

Imports of sheet zinc into the United States since 1923 have been negligible. Exports in 1929 increased 22 per cent over 1928 and amounted to 8 per cent of the total United States production.

Zinc rolled in the United States, 1920–1929

Year	Pounds	Value		Year	Pounds	Value	
		Total	Average			Total	Average
1920	106,467,530	$12,290,233	$0.115	1925	142,263,945	$14,514,234	$0.102
1921	60,800,186	5,940,208	.098	1926	172,668,298	17,880,901	.104
1922	107,018,690	8,546,109	.080	1927	148,259,718	13,671,530	.092
1923	111,666,474	10,164,981	.091	1928	147,061,670	12,364,908	.084
1924	122,064,719	11,552,354	.095	1929	136,667,203	12,105,177	.089

Rolled zinc available for consumption in the United States, 1928 and 1929

	1928			1929		
	Pounds	Value		Pounds	Value	
		Total	Average		Total	Average
Sheet zinc not over 0.1 inch thick	52,082,442	$4,606,138	$0.088	48,715,207	$4,590,772	$0.094
Boiler plate and sheets over 0.1 inch thick	3,833,523	309,531	.081	2,262,341	198,823	.088
Strip and ribbon zinc	91,145,705	7,449,239	.082	85,689,655	7,315,582	.085
Total zinc rolled	147,061,670	12,364,908	.084	136,667,203	12,105,177	.089
Sheet zinc imported for consumption	6,904	2,556		440	52	
Rolled zinc exported	8,649,712	906,515	.105	10,529,333	1,075,000	.102
Available for consumption	138,418,862			126,138,310		
Slab zinc, grades B, C, and D			.061			.065
Spread			.023			.024

The quoted base price of sheet zinc, carload lots, f.o.b. rolling mills, ranged from 9.75 to 10.5 cents per pound during 1929. These quotations, however, are subject to discounts, which may fluctuate, whereas the base quotations remain steady. The average price actually received by rolling mills reporting to the Bureau of Mines was 8.9 cents for all classes of rolled zinc, compared with 8.4 cents in 1928, a rise of 6 per cent. The average price of the grades of slab zinc used in rolling mills increased to 6.5 cents in 1929, so that the value added by rolling amounted to 2.4 cents per pound in 1929, compared with 2.3 cents in 1928 and 2.7 cents in 1927.

The following companies reported production of rolled zinc in the United States in 1929.

Producers of rolled zinc in the United States in 1929

	Location of plant
American Zinc Products Co	Greencastle, Ind.
Atlantic Zinc Works	Brooklyn, N. Y.
Ball Bros. Co	Muncie, Ind.
Edes Manufacturing Co	Plymouth, Mass.
Hazel-Atlas Glass Co	Wheeling, W. Va.
Hegeler Zinc Co	Danville, Ill.
Illinois Zinc Co	Peru, Ill.
Matthiessen & Hegeler Zinc Co	La Salle, Ill.
New Jersey Zinc Co	Palmerton, Pa.
The Platt Bros. & Co	Waterbury, Conn.

ZINC DUST

The commercial production of zinc dust in the United States began in 1910 and reached a maximum in 1920, when it amounted to approximately 11,500 tons. From 1922 to 1927 the annual production averaged about 8,000 tons. In 1929, 11,050 tons was produced, an increase of 20 per cent over 1928.

Zinc dust varies in composition but on the average contains about 90 per cent of metallic zinc and 10 per cent of zinc oxide, the latter occurring as a film on the surface of the metallic particles. Before 1926 two varieties of zinc dust—"blue powder" and "atomized"—were marketed; the former was produced by the distillation of zinc and the latter by ejecting molten metal from the nozzle under pressure. No atomized zinc dust was sold in 1926 or 1927, but in 1928 and 1929 production of the commodity for market was resumed. The Anaconda Copper Mining Co., the Sullivan Mining Co., and the Evans-Wallower Zinc Co. produce some atomized zinc dust, but as their entire product is used as a purifying agent in their electrolytic zinc plants and eventually enters the market as slab zinc it is not included in the figures given in the following table.

Zinc dust sold by producers in the United States, 1920–1929

Year	Prepared "blue powder"			Zinc dust "atomized"			Primary zinc recovered as zinc dust (short tons)[1]
	Short tons	Value		Short tons	Value		
		Total	Average per pound		Total	Average per pound	
1920	9,066	$2,009,117	$0.111	2,463	$555,773	$0.113	6,425
1921	2,006	333,390	.083	999	152,151	.076	1,380
1922	3,394	531,225	.078	3,859	573,220	.074	2,113
1923	3,676	643,766	.088	4,376	702,923	.080	2,450
1924	3,894	620,078	.080	4,063	621,221	.076	1,861
1925	[2] 8,314	[2] 1,500,758	[2] .090	(2)	(2)	(2)	2,251
1926	7,994	1,490,293	.093	---	---	---	2,794
1927	8,098	1,345,105	.083	---	---	---	3,249
1928	[2] 9,172	[2] 1,475,875	[2] .080	(2)	(2)	(2)	2,668
1929	[2] 11,050	[2] 1,864,672	[2] .084	(2)	(2)	(2)	3,263

[1] The amount of secondary zinc recovered in zinc dust, 1926–1929, is shown in the table on secondary zinc, p. 685.

[2] Figures for "atomized" included under "blue powder." Bureau of Mines not at liberty to publish figures separately.

One of the chief uses of zinc dust is in the sherardizing process, wherein metal articles are given a zinc coating by heating with zinc dust in a sealed container. It is said that the zinc vaporizes at a temperature below its melting point and that the vapor forms an alloy on the surface of the metals to be coated. The process is especially adapted to the coating of quantities of small articles and threaded hardware, such as screws, bolts, and nuts. Zinc dust is also used as a reducing agent in the manufacture of dyes, as a precipitant of gold in the cyanide process, and as a pigment in paints, especially marine paints.

The following companies reported the production and sale of zinc dust in 1929.

Producers of zinc dust in the United States in 1929

	Location of plant
The Alloys Co	San Francisco, Calif.
American Smelting & Refining Co	Sand Springs, Okla.
Federated Metals Corporation	Trenton, N. J.
John Finn Metals Works	San Francisco, Calif.
Grasselli Chemical Co	Meadowbrook, W. Va.
New Jersey Zinc Co	Palmerton, Pa.
Superior Zinc Corporation	Philadelphia, Pa.

ZINC PIGMENTS AND SALTS

Zinc oxide, leaded zinc oxide, and lithopone are the principal pigments of zinc, and the chloride and sulphate are the principal salts. These products are manufactured from various zinciferous materials, such as ores, metal, and secondary substances. In 1929 the total zinc content of all zinc pigments and salts produced in the United States amounted to 203,552 tons, an increase of 9 per cent over 1928. This was derived from the following sources:

Zinc content of zinc pigments and salts made in the United States, 1928 and 1929, by sources, in short tons

Source	1928	1929
Domestic ore	124,090	137,892
Metal	37,588	39,620
Secondary material	25,353	26,040
	187,031	203,552

The following table gives the primary zinc content (that is, zinc derived directly from ores) of zinc pigments and salts produced for market in the United States during the last 10 years:

Primary zinc content of zinc pigments and salts made in the United States, 1920–1929, in short tons[1]

Year	Pigments	Salts	Year	Pigments	Salts
1920	110,695	6,284	1925	110,554	673
1921	53,480	3,749	1926	127,685	(2)
1922	93,112	1,801	1927	121,899	(2)
1923	115,970	1,573	1928	123,964	(2)
1924	108,282	1,075	1929	137,147	(3)

[1] Includes some zinc derived from primary drosses from zinc-reduction plants.
[2] Figures published in earlier reports of this series have been revised, and the Bureau of Mines is not at liberty to publish the revised figures.
[3] Bureau of Mines not at liberty to publish figures.

The use of zinc ore and metallic zinc in the manufacture of pigments and salts increased 11 and 5 per cent, respectively, in 1929, whereas the use of secondary material remained constant.

Ore was used in the following products in 1929, the percentages representing proportion of the total zinc recoverable from the ore entering the various pigments:

	Per cent
American process zinc oxide	71
Lithopone	21
Leaded zinc oxide	8

The metallic zinc was practically all used in the manufacture of French process zinc oxide. The secondary zinc was distributed as follows:

	Per cent
Lithopone	50
Zinc salts	38
Leaded zinc oxide	12

Further details of the production of zinc pigments and salts are given in the Mineral Resources chapter on Lead and Zinc Pigments and Salts.

SECONDARY ZINC

The accompanying table, compiled by J. P. Dunlop, of the Bureau of Mines, shows the amount of secondary zinc recovered in the United States as metal and in zinc dust, zinc pigments, and zinc salts, 1926 to 1929.

Secondary zinc recovered in the United States, 1926–1929, in short tons

	1926	1927	1928	1929
Secondary zinc, redistilled	40,799	42,784	48,666	47,348
Secondary zinc, remelted	23,771	22,016	22,034	18,052
Total zinc recovered unalloyed	64,570	64,800	70,700	65,400
Recovered zinc in alloys, excluding old brass remelted	13,430	12,400	12,500	11,600
Recovered zinc in remelted brass (estimated)	63,000	63,200	66,000	65,670
Secondary zinc recovered as metal	141,000	140,400	149,200	142,670
Secondary zinc recovered in zinc dust	4,400	4,400	5,600	6,700
Secondary zinc recovered in pigments	12,480	14,000	14,900	16,000
Secondary zinc recovered in zinc salts	10,084	9,544	10,500	10,000
Total secondary zinc	168,000	168,300	180,200	175,400

The recovery of secondary zinc decreased 3 per cent in 1929, whereas the production of primary zinc increased 4 per cent.

Secondary zinc recovered in the form of metal decreased 4 per cent, due to decreases of 3 per cent in redistilled secondary zinc, 18 per cent in remelted zinc, 7 per cent in alloys other than old brass, and 0.5 per cent in remelted brass; that recovered in dust, pigments, and salts increased 5 per cent.

Since 1910, the first year for which satisfactory data are available, production of secondary zinc has shown a remarkable increase, but as the production of primary zinc has increased at about the same rate, there has been little change in the ratio of secondary to primary zinc. From 1910 to 1914 the recovery of secondary zinc as metal was equivalent to 23 per cent of the total primary zinc output. During the war and postwar periods the ratio was upset by extraordinary conditions, but during the last five years it again averaged 23 per cent. In 1929 the ratio was also 23 per cent. The corresponding ratio for both copper and lead in 1929 was 46 per cent. This relatively advantageous position of zinc is probably due to the large percentage consumed in dissipative uses, such as zinc coatings, zinc dust, pigments, and salts which yield little secondary metal. It is estimated that less than 35 per cent of all the zinc mined each year is ever available for secondary usage.

BY-PRODUCT SULPHURIC ACID

An important by-product of zinc-smelting operations is the sulphuric acid made from the sulphur gases evolved in roasting zinc sulphide ores preparatory to their reduction to metal or conversion to zinc oxide or to zinc salts. Sulphur gases from zinc ores were first thus utilized in the United States in 1882 by Matthiessen & Hegeler at La Salle, Ill., but now these gases are used at numerous acid plants, which may be at zinc smelters and zinc oxide plants, at roasting and magnetic separating plants, at the mines, or nearer the acid markets, the roasted concentrates being shipped to the smelters or to other zinc plants.

For several years the demand for sulphuric acid has been strong, and to utilize their acid-plant capacities producers have been forced to burn large quantities of sulphur to supplement the gases derived from the roasting of zinc blende; thus the acid production recorded as a by-product of zinc smelting has been derived from two sources—zinc ores and sulphur.

The following table gives the total quantity and value of sulphuric acid of different strengths produced and sold by plants associated with zinc-blende roasting operations:

By-product sulphuric acid produced at zinc-blende roasting plants in the United States, 1926–1929

	1926	1927	1928	1929
Number of establishments	22	22	21	21
Acid reported as 50°–60° B.:				
Produced (expressed as 60° B.) short tons	647, 380	605, 086	643, 407	694, 990
Consumed at works (expressed as 60° B.) do	37, 555	34, 586	32, 680	33, 474
Sold (expressed as 60° B.) do	615, 356	572, 347	618, 010	657, 785
Value of acid sold—				
Total	$5, 839, 666	$5, 588, 204	$6, 109, 459	$6, 336, 444
Average	$9. 49	$9. 76	$9. 89	$9. 63
Acid reported as 66° B. and stronger:				
Produced (expressed as 66° B.) short tons	401, 841	401, 290	384, 445	482, 507
Consumed at works (expressed as 66° B.) do	50, 412	48, 637	34, 742	67, 670
Sold (expressed as 66° B.) do	364, 706	334, 470	365, 596	441, 617
Value of acid sold—				
Total	$4, 935, 104	$4, 752, 736	$5, 077, 475	$6, 381, 556
Average	$13. 53	$14. 21	$13. 89	$14. 45
Total acid sold, equivalent in 60° B.:				
Quantity short tons	1, 053, 003	973, 711	1, 056, 725	1, 187, 726
Value	$10, 774, 770	$10, 340, 940	$11, 186, 934	$12, 718, 000
Total acid consumed at works (60° B.) short tons	98, 049	92, 950	74, 370	114, 678

The total production of sulphuric acid (60° B.) at zinc-blende roasting plants in 1929 amounted to 1,273,998 tons, an increase of 15 per cent over 1928 and about 20 per cent of the total output of sulphuric acid in the United States, as estimated by Chemical and Metallurgical Engineering.[3]

The quantity of acid sold by zinc plants in 1929 exceeded that in 1928 by 12 per cent. The average price received for 60° B. acid decreased $0.26 per ton in 1929. The average sales price of 66° B. and stronger acids increased 4 per cent in 1929. The total value of all sales increased 14 per cent in 1929. Sales of 60° B. acid increased 6 per cent, while production increased 8 per cent. Sales of 66° B. acid increased 21 per cent, while production increased 26 per cent. Statistics indicate that producers' stocks of 60° acid increased slightly and those of 66° acid decreased substantially in 1929.

The following statement shows the quantity of blende and sulphur used and the production and value of the acid made from each.

Production and value of sulphuric acid made from blende and sulphur at zinc-blende roasting plants in the United States, 1928 and 1929

	1928	1929
Number of establishments	21	21
Blende used short tons	621, 158	682, 666
Acid made, equivalent in 60° B do	558, 537	627, 018
Value at average of sales of 60° B	$5, 523, 931	$6, 038, 183
Sulphur used short tons	147, 026	176, 525
Acid made, equivalent in 60° B do	546, 204	646, 980
Value at average of sales of 60° B	$5, 401, 958	$6, 230, 417
Total quantity of acid made (60° B.) short tons	1, 104, 741	1, 273, 998
Total value of acid made	$10, 925, 889	$12, 268, 600

In 1929, 49 per cent of the acid made at zinc plants was derived from blende and 51 per cent from sulphur, compared with 51 and 49 per cent, respectively, in 1928. Ten per cent more blende was used and 12 per cent more acid was made from blende in 1929 than in 1928.

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[3] Chemical and Metallurgical Engineering, January, 1930, p. 20. Estimated production for 1929 was 7,925,000 tons of 50° B. acid, equivalent to 6,345,000 tons of 60° B. acid.

Acid made from blende in 1929 was 10 per cent of the total production of the United States. The quantity of sulphur used at zinc plants increased 20 per cent in 1929 and the acid produced therefrom increased 18 per cent.

A list of operators in 1929, with the location of their acid plants, follows. Plants at zinc smelters are also indicated in the list of zinc-reduction plants on page 689. The American Zinc Oxide Co., of Columbus, Ohio, has a zinc-roasting plant and disposes of the sulphur gases to the neighboring plant of the Farmers Fertilizer Co.

Producers of by-product sulphuric acid at zinc-blende roasting plants in the United States in 1929

	Location of plant
American Steel & Wire Co	Donora, Pa.
American Zinc & Chemical Co	Langeloth, Pa.
American Zinc Co. of Illinois	East St. Louis, Ill.
Do	Hillsboro, Ill.
American Zinc Oxide Co	Columbus, Ohio.
Eagle-Picher Lead Co	Hillsboro, Ill.
Grasselli Chemical Co	Grasselli, Ind.
Do	Canton, Ohio.
Do	Cleveland, Ohio.
Do	Lockland, Ohio.
Do	Niles, Ohio.
Do	New Castle, Pa.
Hegeler Zinc Co	Danville, Ill.
Illinois Zinc Co	Peru, Ill.
Matthiessen & Hegeler Zinc Co	La Salle, Ill.
Mineral Point Zinc Co	Depue, Ill.
Monsanto Chemical Co	East St. Louis, Ill.
National Zinc Co	Bartlesville, Okla.
National Zinc Separating Co. [4]	Platteville, Wis.
New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.
United Zinc Smelting Corporation	Moundsville, W. Va.

MINE PRODUCTION

The following table shows the mine production of zinc in the United States, by States, during the past 10 years.

Mine production of recoverable zinc in the United States, 1920–1929, in short tons

State	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Arizona	729	--------	105	260	--------	3,666	6,473	1,134	639	1,229
Arkansas	329	15	134	148	4	43	87	128	86	9
California	583	423	1,506	--------	1,530	5,745	10,217	4,031	--------	--------
Colorado	24,395	1,180	11,629	27,076	28,364	30,811	32,500	35,865	35,731	29,431
Idaho	13,966	17	2,055	13,976	7,670	15,619	26,307	26,778	31,263	45,675
Illinois	4,720	2,426	3,124	1,266	2,512	2,724	2,577	521	17	31
Kansas	61,073	36,994	56,225	100,969	105,392	118,778	126,307	109,427	107,251	109,850
Kentucky	9	220	142	270	492	429	1,838	860	92	--------
Missouri	24,509	10,845	16,171	18,265	12,920	14,794	26,018	18,737	12,974	11,017
Montana	92,169	11,638	59,535	70,730	64,238	57,658	73,701	80,231	82,830	68,176
Nevada	5,349	35	1,309	7,083	5,501	7,411	5,409	3,172	3,398	8,460
New Jersey	78,511	56,447	73,657	75,227	84,370	89,261	80,629	95,695	99,871	103,740
New Mexico	5,007	114	2,248	8,248	10,380	9,246	12,052	29,802	31,203	34,455
New York	5,654	1,572	4,816	8,463	4,664	5,158	5,041	3,750	11,257	10,250
Oklahoma	219,727	121,372	209,682	242,421	269,137	283,371	272,567	206,611	180,252	192,042
Tennessee	19,217	9,692	15,568	15,900	14,376	16,256	12,098	10,400	[a] 32,917	[a] 40,558
Utah	4,079	35	2,560	5,665	9,281	26,306	47,590	49,593	46,929	51,510
Virginia	--------	--------	--------	--------	2,664	2,732	5,830	8,325	([a])	([a])
Washington	213	225	614	1,512	455	609	522	640	43	1,059
Wisconsin	27,285	3,390	10,952	13,211	14,027	20,230	26,800	32,841	18,417	16,986
	587,524	256,640	472,032	610,690	637,977	710,847	774,563	718,541	695,170	724,478

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[a] Bureau of Mines not at liberty to publish figures for Virginia for 1928 and 1929. These figures are included in the total for Tennessee.

[4] Acidmade chiefly from partly desulphurized pyrite tailings from magnetic separating plant.

The mine production of zinc in the United States in 1929 amounted to 724,478 tons, an increase of 4 per cent over 1928. The largest increase (7 per cent) was recorded by the Eastern and Southern States, which produced 21 per cent of the United States total. The Mississippi Valley States with a 3 per cent increase in output produced 46 per cent of the total. The output of the Western States also increased 3 per cent; it amounted to 33 per cent of the total.

The tri-State district (Joplin region) output increased 4 per cent in 1929 and amounted to 94 per cent of the total for the Mississippi Valley States and 43 per cent of the total for the country. The six principal producing States furnished the following percentages of the country's total: Oklahoma 27 per cent, Kansas 15 per cent, New Jersey 14 per cent, Montana 9 per cent, Utah 7 per cent, and Idaho 6 per cent. Of these States Idaho had the largest increase, amounting to more than 14,000 tons or 46 per cent and due to the large increase in production at the Sullivan mine, which began operations in the latter part of 1928; the other States showed increases in 1929 except Montana, where a decline of 18 per cent, due to curtailment of zinc-mining operations in the Butte district, was recorded.

Large increases in production were recorded in Oklahoma, the Tennessee-Virginia area, in Nevada, and in New Mexico; decreases were recorded in Colorado, Missouri, Wisconsin, and New York. Nevada's increase was due largely to the larger output of the Combined Metals Reduction Co. in the Pioche district.

Detailed information concerning the mining activities in the various districts of the United States can be found in the chapters of this series dealing with the mine production of gold, silver, copper, lead, and zinc in the various States.

FLOTATION CONCENTRATES

The widespread adoption of selective flotation in the United States since 1921 is well illustrated in the following table, which shows the production of zinc flotation concentrates, exclusive of the tri-State district, from 1921 to 1929:

Zinc flotation concentrates produced in the United States, exclusive of the tri-State district, 1921–1929 [1]

Year	Concentrates (short tons)	Zinc content		Lead content	
		Short tons	Tenor, per cent	Short tons	Tenor, per cent
1921	38, 433	15, 311	39. 84	4, 457	11. 60
1922	82, 121	37, 116	45. 20	6, 105	7. 43
1923	169, 496	83, 778	49. 42	11, 181	6. 60
1924	227, 955	109, 005	47. 82	14, 368	6. 30
1925	253, 989	130, 594	51. 42	11, 064	4. 36
1926	404, 485	208, 834	51. 63	16, 722	4. 13
1927	500, 932	265, 807	53. 06	12, 316	2. 46
1928	559, 626	298, 638	53. 36	17, 441	3. 12
1929	564, 274	306, 906	54. 39	15, 303	2. 71

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[1] Year Book, American Bureau of Metal Statistics, 1929.

ZINC-REDUCTION PLANTS

ZINC SMELTERS

The number of retorts at zinc smelters active in 1929 was 2 per cent less than in 1928 and the output of smelted primary zinc was 6 per cent more. Some time during the year 21 smelters containing 105,825 retorts were active, whereas in 1928 there were 21 active plants with 107,528 retorts. The United States Zinc Co. plant at Henryetta, Okla., was shut down in July, 1928, and abandoned. The Matthiessen & Hegeler Zinc Co. reported the completion of 144 new retorts in its plant at La Salle, Ill. In May, 1930, the St. Joseph Lead Co. began construction of a zinc smelter near Monaca, Pa., which will treat 120 tons of zinc concentrates per day from the company's New York mines and produce metallic zinc, zinc oxide, and by-product sulphuric acid; a new electrothermic process of smelting will be employed. The Bartlesville (Okla.) plant of the American Metal Co. was sold for scrap during the latter part of 1929. The United States Zinc Co. surrendered its lease on the Kusa smelter in 1927, and this plant was operated in 1929 by the owner, George E. Nicholson.

At the end of the year 20 smelters were in operation, using 62,722 retorts, or about 62 per cent of the available retorts in these plants. On December 31, 1928, 63,716 retorts, or 60 per cent of the available retorts at producing plants, were in use.

The following table shows the zinc-smelting plants operating in the United States in 1929:

Zinc-smelting plants operating in the United States in 1929

Operating company (A=acid plant located at the smelter)	Location of plant	Retorts
ARKANSAS		
Athletic Mining & Smelting Co	Fort Smith	3, 328
ILLINOIS		
American Zinc Co. of Illinois (A)	East St. Louis	5, 760
Hegeler Zinc Co. (A)	Danville	5, 400
Illinois Zinc Co. (A)	Peru	4, 400
Matthiessen & Hegeler Zinc Co. (A)	La Salle	6, 276
Mineral Point Zinc Co. (A)	Depue	8, 309
Missouri Zinc Co	Beckemeyer	640
INDIANA		
Grasselli Chemical Co	Terre Haute	4, 200
KANSAS		
Edgar Zinc Co	Cherryvale	5, 160
Weir Smelting Co	Caney	1, 920
OKLAHOMA		
Blackwell Zinc Co. (Inc.)	Blackwell	9, 600
Eagle-Picher Lead Co	Henryetta	4, 800
National Zinc Co. (A)	Bartlesville	4, 256
George E. Nicholson	Kusa	3, 760
Quinton Spelter Co	Quinton	3, 360
PENNSYLVANIA		
American Steel & Wire Co. (A)	Donora	7, 904
American Zinc & Chemical Co. (A)	Langeloth	4, 864
New Jersey Zinc Co. (of Pennsylvania) (A)	Palmerton	7, 200

Zinc-smelting plants operating in the United States in 1929—Continued

Operating company (A=acid plant located at the smelter)	Location of plant	Retorts
TEXAS		
American Smelting & Refining Co	Amarillo	5,600
WEST VIRGINIA		
Grasselli Chemical Co	Meadowbrook	6,720
United Zinc Smelting Corporation (A)	Moundsville	2,368
		105,825

In addition to these smelters the following operators treated secondary materials in large graphite retorts in 1929:

Birmingham Smelting & Refining Co., Birmingham, Ala.
General Smelting Co., Philadelphia, Pa.
Superior Zinc Corporation, Philadelphia, Pa.
Tottenville Copper Co., Tottenville, N. Y.
Trenton Smelting & Refining Branch of Federated Metals Corporation, Trenton, N. J.
Wheeling Steel Corporation, Wheeling, W. Va.

ELECTROLYTIC PLANTS

Two processes for making electrolytic zinc have been developed commercially in the United States. The first was developed by the Anaconda Copper Mining Co. and the first large installation was made at Great Falls, Mont., in 1916. The second process, known as the Tainton, was first used commercially in the Sullivan plant in Idaho.

Both processes follow the same general procedure. Zinc-bearing material is subjected to a roast, which converts the zinc minerals to the soluble oxide and sulphate. The calcine is treated with sulphuric acid solution, which dissolves out the zinc content. The zinc-bearing solution is then purified and the zinc precipitated electrolytically.

The essential differences in the two processes are in the strength of acid used in the leach and the current density at which electrodeposition is carried on. The Tainton process uses stronger acid and a higher current density than the Anaconda. Both processes were described briefly in the 1928 chapter of this series.

Operations at the new 50-ton Tainton electrolytic zinc plant of the Evans-Wallower Zinc Co. at Monsanto, East St. Louis, Ill., began in September, 1929, and by the end of the year the plant was producing at full capacity The plant of the Sullivan Mining Co. at Kellogg, Idaho, and the Anaconda (Mont.) plant of the Anaconda Copper Mining Co. were operated at approximately full capacity throughout the year, but production at the Great Falls (Mont.) plant of the Anaconda Copper Mining Co. was substantially curtailed. The United Verde Copper Co., of Jerome, Ariz., is working out a scheme for the recovery of zinc from the copper ore body. The flow sheet includes an electrolytic zinc plant, and early in 1930 a test plant was being erected at Clarkdale, Ariz.

The following table summarizes data on the electrolytic zinc plants in the United States.

Electrolytic zinc plants in operation and under construction in the United States in 1929

Company	Location	Year completed	Number of cells	Maximum daily capacity in short tons of refined zinc
Anaconda Copper Mining Co	Great Falls, Mont	1916 and later enlarged.	1,164	350
Do	Anaconda, Mont	1928	576	175
Sullivan Mining Co	Kellogg, Idaho	1928	300	65
Evans-Wallower Zinc Co	East St. Louis, Ill	1929	190	55

WORLD ASPECTS

WORLD MINE PRODUCTION

Compilation of the world mine production of zinc is at best a difficult task, owing to complete lack of published data for some countries and to lack of uniformity in reports from the countries that do publish production data. The following table, compiled from official and semiofficial sources, is submitted as a partial record of the world mine production during the last five years. Supplementary data, based in part on estimates, are given in the yearbooks of the American Bureau of Metal Statistics and the Metallgesellschaft.

World mine production of zinc, 1925–1929, in metric tons[1]

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1925	1926	1927	1928	1929
North America:					
Canada[2]	49,563	68,010	75,067	83,754	89,478
Mexico	51,795	105,367	137,724	161,747	174,050
Newfoundland	----------	----------	----------	(3)	(3)
United States[4]	644,866	702,668	651,846	630,644	657,232
	746,224	876,045	864,637	876,145	920,760
South America:					
Bolivia (exports)	2,750	7,601	5,637	2,261	1,395
Chile	90	453	1,003	499	(5)
Peru	14,418	22,975	21,589	28,587	(5)
	17,258	31,029	28,229	31,347	[6]30,000
Europe:					
Austria	1,908	2,248	3,502	3,156	3,960
Belgium	5,000	6,000	7,000	[6]6,000	(5)
Bulgaria[7]	----------	(7)	(7)	(7)	(7)
Czechoslovakia	532	268	848	528	(5)
Finland	----------	638	1,189	660	380
France	4,824	5,737	8,600	9,400	9,600
Germany	69,297	104,424	141,629	144,386	142,467
Great Britain	749	854	1,272	720	864
Greece	2,018	6,005	6,110	4,476	(5)
Italy	69,643	74,703	85,393	84,840	79,844
Norway	327	32	108	22	1,446
Poland	140,000	148,900	125,500	114,500	140,000
Portugal	33	212	153	[6]200	[6]200

[1] Figures represent estimated content of ores or concentrates produced, except as otherwise noted.

[2] Smelter production plus estimated content of ores and concentrates exported.

[3] Production of zinc-lead ore reported as follows: 1928, 34,519 tons; 1929, 165,732 tons. No data available on zinc content.

[4] Production of recoverable zinc.

[5] Data not available.

[6] Approximate production.

[7] Production of ore reported as follows: 1926, 425 tons of zinc ore; 1927, 1,495 tons of zinc ore and 6,720 tons of lead-zinc ore; 1928, 14,762 tons of lead-zinc ore; 1929, 1,365 tons of zinc ore and 10,846 tons of lead-zinc ore. No data available on zinc content.

World mine production of zinc, 1925–1929, in metric tons—Continued

Country	1925	1926	1927	1928	1929
Europe—Continued.					
Russia[8]	[9]1,500	[9]1,900	[9]2,300	[9]2,300	[9]4,400
Spain	48,816	58,829	47,057	44,906	50,909
Svalbard	153	83	15		
Sweden	18,636	21,307	24,372	14,172	29,992
Yugoslavia	236	173	325	345	340
	[9]363,672	[9]432,313	[9]455,373	[9]430,611	[9]475,000
Asia:					
China	13,000	12,000	[6]10,000	[6]5,000	[6]5,000
Chosen	(10)	(10)	(10)	(10)	(10)
India, British[11]	7,750	23,048	27,508	32,901	30,760
Indo-China	20,792	25,053	21,800	21.486	18,760
Japan[6]	10,000	12,000	10,000	10,000	10,000
Russia[8]	(9)	(9)	(9)	(9)	(9)
Turkey				2,000	4,000
	[9]51,542	[9]72,101	[9]69,308	[9]71,387	[9]68,520
Africa:					
Algeria	22,702	28,032	21,513	15,098	14,943
Egypt			306		587
Kenya Colony			(12)		
Morocco, French	13	34	71	200	989
Nigeria			10	61	
Rhodesia—					
Northern Rhodesia	2,000	149		13,387	22,587
Southern Rhodesia				165	
Tunisia	9,000	10,000	7,800	3,500	4,000
	33,715	38,215	29,700	32,411	43,106
Oceania:					
Australia	141,010	153,298	174,283	150,236	157,043
New Caledonia	620	638	450		(5)
	141,630	153,936	174,733	150,236	157,043
	1,354,000	1,604,000	1,622,000	1,592,000	1,694,000

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(5) Data not available.

(6) Approximate production.

(8) Year ended Sept. 30.

(9) Small output from Russia in Asia is included under Russia in Europe.

(10) Production of zinc ore reported as follows: 1925, 3,579 tons; 1926, 7,107 tons; 1927, 3,684 tons; 1928, 5,322 tons; 1929, 5,109 tons. No data available on zinc content.

(11) Estimated zinc content of concentrates produced by the Burma Corporation (Ltd.) in Burma.

(12) Production of 12 tons of zinc ore reported, zinc content not stated.

In 1929 the world produced ore containing approximately 1,694,000 metric tons of zinc, of which North America contributed 54 per cent, Europe 28 per cent, Oceania 9 per cent, Asia 4 per cent, and Africa and South America 3 and 2 per cent, respectively. Only six countries contributed 5 per cent or more of the world total. They were United States 39 per cent, Mexico 10 per cent, Australia 9 per cent, Germany 8 per cent, Poland 8 per cent, and Canada 5 per cent.

Metallgesellschaft estimates the 1929 world output at 1,669,400 metric tons, an increase of 8 per cent over its estimate of 1,544,200 tons for 1928.

WORLD SMELTER PRODUCTION

The following table shows the world smelter production of zinc from 1925 to 1929, as far as statistics are available. Official figures are used wherever possible. For countries for which official data are not yet available the figures are taken from the Year Book of the American Bureau of Metal Statistics and other reliable sources, but the official statistics will be substituted as received.

There is always possibility of duplication in figures showing European production, as some countries send crude zinc of poor quality to other countries for refining. Furthermore, secondary zinc probably is included in figures of production reported by some foreign countries. The figures for such countries are therefore not fully comparable with the figures for production of primary zinc in the United States, as given in the following table.

World smelter production of zinc, 1925–1929, in metric tons, by countries where smelted

[Compiled by L. M. Jones, of the Bureau of Mines]

Country	1925	1926	1927	1928	1929
Australia	46,431	48,116	49,944	51,029	52,705
Belgium	170,860	188,767	199,090	206,300	201,380
Canada	34,892	55,998	66,413	74,176	78,061
China	305	300	(1)	(1)	(1)
Czechoslovakia	3,042	2,789	6,324	8,039	10,675
France	64,256	64,188	82,605	96,873	91,600
Germany	62,494	73,716	89,837	104,707	105,326
Great Britain	38,761	18,278	42,541	56,284	59,234
Indo-China	1,158	1,858	1,170	2,8[illegible]7	3,808
Italy	6,478	7,636	7,367	10,654	15,804
Japan	16,950	16,972	17,498	19,117	[2] 23,000
Mexico	1,304	5,967	6,432	11,220	15,099
Netherlands	21,117	24,796	26,268	26,857	25,712
Northern Rhodesia	240	240	------	9,751	12,316
Norway	6,807	5,359	5,488	------	5,516
Poland	114,339	123,741	150,299	161,815	169,029
Russia[3]	1,492	1,888	2,266	4,300	4,403
Spain	15,122	16,065	16,531	13,549	11,825
Sweden	4,672	4,766	4,647	5,106	4,718
United States	519,765	561,020	537,519	546,649	567,393
Yugoslavia	2,075	2,376	3,185	4,883	6,291
	1,133,000	1,225,000	1,315,000	1,414,000	1,464,000

[1] Data not available. [2] Approximate production. [3] Year ended Sept. 30.

The world smelter production of zinc in 1929 exceeded all previous records and amounted to 1,464,000 metric tons or 3.5 per cent more than that for 1928. The American Bureau of Metal Statistics estimates the 1929 output at 1,470,769 metric tons and Metallgesellschaft at 1,463,000 metric tons.

Only eight countries produced more than 3 per cent of the world's zinc in 1929. They were United States 39 per cent, Belgium 14 per cent, Poland 12 per cent, Germany 7 per cent, France 6 per cent, Canada 5 per cent, Great Britian 4 per cent, and Australia 4 per cent.

Noteworthy tonnage increases were recorded in the United States, Poland, Italy, Norway, Canada, Japan, Mexico, Great Britain, Czechoslovakia, and Northern Rhodesia; the chief decreases occurred in France, Belgium, and Spain.

The world production of electrolytic zinc is expanding rapidly. The American Bureau of Metal Statistics reports the 1929 output at 360,539 short tons, which is 9 per cent greater than that in 1928 and represents 22 per cent of the total zinc produced. In 1929 the United States produced 43 per cent of the world total, Canada 24 per cent, and Australia 16 per cent. France, Poland, Northern Rhodesia, Italy, Norway, and Japan contributed the remaining 17 per cent. The maximum daily capacity of all plants operating in 1929 was 1,618 short tons. At the end of the year additional installations totaling 300 short tons were under construction at Flin Flon, Manitoba, Canada; Magdeburg, Germany; and Kamien, Poland. Capacity was being increased at Risdon, Tasmania. In addition, the Soviet

Government projects electrolytic plants at the Ridder mine in Kazakstan (17,000 tons annual capacity); in the Urals (10,000 tons capacity); and at Belovo in the Kuznetzk coal district in Siberia (20,000 tons capacity). Additional installations are projected in Canada at Isle Perrot, Quebec, by Consolidated Mining & Smelting Co. and Ventures (Ltd.) jointly, and in France by Société Minière et Métallurgique de Peñarroya.

WORLD ZINC INDUSTRY

Summaries of the zinc industry in the more important zinc-producing countries follow.

ALGERIA

The production of zinc ore in Algeria during 1929 amounted to 34,605 metric tons, compared with 34,972 tons in 1928 and 47,940 tons in 1927. Exports amounted to 29,153 tons, most of which went to Belgium.

AUSTRALIA

Australia ranked third in mine production of zinc in 1929, having produced ores and concentrates containing about 155,000 long tons of zinc—an increase of 5 per cent over 1928. About two-thirds of the output is usually shipped to European smelters, and one-third is treated at the electrolytic zinc plant at Risdon, Tasmania, where nearly 52,000 tons of zinc were produced during 1929. About 33,000 long tons of zinc were exported during the year, of which Japan took 38 per cent and Great Britain 26 per cent. In addition, ores and concentrates containing about 74,500 tons of zinc were exported. The major part of the zinc produced in Australia comes from New South Wales, but increased production is expected from Queensland and Tasmania within the next few years.

Considerable apprehension was felt over the termination of the contract with the British Board of Trade in June, 1930, under which Australian concentrates were marketed at a price considerably above the open market. Purchases under this contract resulted in a loss of £5,800,000 to the Board of Trade from April, 1918, to March, 1929. At the expiration of the contract in 1930 it was reported that the board's stock pile at Broken Hill contained more than 200,000 tons of zinc concentrates, or enough to supply the Risdon plant with raw material for two years.

New South Wales.—The Broken Hill district has supplied the larger part of the Australian zinc production since about 1894. In 1929, 1,229,189 long tons of ore were mined, an increase of 6 per cent over 1928. The ore mined from 1903 to 1929, inclusive, totaled 31,200,000 tons. In 1929 the ore averaged about 14 per cent lead, 11 per cent zinc, and 6 or 7 ounces silver.

The principal zinc-producing companies in 1929 were North Broken Hill (Ltd.), Broken Hill South (Ltd.), Zinc Corporation (Ltd.), and the Sulphide Corporation (Ltd.). The Broken Hill Proprietary and the Block 14 Co. produced small quantities of zinc concentrates. Details of the production of most of these companies are included in the 1929 Mineral Resources chapter on Lead.

According to the president[5] of the Broken Hill Mine Managers' Association the ore reserves of the Broken Hill district in 1910 were estimated at 13,085,000 tons. Since that time 23,000,000 tons have been produced and the reserves are still at least equal to or probably greater than the 1910 estimate.

Some important developments at the principal properties follow:

The Sulphide Corporation (Ltd.) produced (at its Cockle Creek roasting plant) about 23,000 tons of sulphuric acid, which was used in the manufacture of superphosphates. A new ore body which shows promise was encountered 55 feet below the 1,400-foot level. The capacity of the concentrator was increased to 1,000 tons daily to take care of ores from the Broken Hill Proprietary and Block 14 mines in addition to its own Central mine which was operated throughout the year. The Junction mine was inactive until its acquisition by North Broken Hill (Ltd.) on October 1, 1929.

The Zinc Corporation (Ltd.) closed its zinc-roasting plant in December due to the substitution of sodium carbonate for sulphuric acid in flotation treatment.

The North Broken Hill (Ltd.) acquired the Junction mine from the Sulphide Corporation and during the latter part of the year was opening up ore in the lower levels. The North and British mines operated continuously. The zinc section of the mill was closed down in the latter part of 1930 because of poor market conditions after the termination of the British Board of Trade contract.

The remodeling of the gravity plant of the Broken Hill South concentrator was completed during the latter part of the year. Experiments looking toward improvement in flotation practice were continued during 1929. The company suspended production of zinc concentrates in September, 1930, owing to poor market conditions.

The North Broken Hill (Ltd.), Broken Hill South (Ltd.), and the Zinc Corporation (Ltd.) have combined to erect a central power plant to reduce the cost of power. The plant will contain six 3,000-horsepower Diesel engines and a central air-compressor plant. The same companies control the Broken Hill Associated Smelters Proprietary (Ltd.), which operates a lead smelter at Port Pirie, and the Electrolytic Zinc Co., which has an electrolytic zinc plant at Risdon, Tasmania. The Electrolytic Zinc Co. was increasing its electrolytic zinc plant to handle 70,000 tons of zinc annually. The new plant was scheduled for completion by the end of 1930, but it was reported that the addition had been postponed, presumably on account of the company's association with the European Zinc Cartel.

Broken Hill Proprietary and Block 14 mines began operating the latter part of 1929. The ore was milled in the Sulphide Corporation mill.

The Captain's Flat district, New South Wales, promises to become an important producer of zinc. Ore reserves at the Lake George mine as of December 31, 1929, were reported at 1,975,359 tons, containing 7.59 per cent lead, 12.93 per cent zinc, 0.76 per cent copper, 2.4 ounces silver, and 1.28 pennyweight gold. The lode is said to be capable of yielding at least 5,000,000 tons of ore. The Lake George Metal Corporation (Ltd.) has acquired the options held by Camp Bird (Ltd.) and National Mining Corporation (Ltd.). A pilot plant was started up in September and operations demonstrated the practicability of the recovery of high-grade lead and zinc concentrates. A plant capable of treating 180,000 tons of ore yearly was being designed in May, 1930. A 27-mile railway from Bungendore was being considered.

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[5] Min. Jour., London, vol. 166, No. 4910, Sept. 28, 1929, p. 783.

Queensland.—The Russo-Asiatic Co. has made rapid progress in developing and equipping its Mount Isa project. Production of lead from the first 500-ton unit of a 2,000-ton plant was expected early in 1931. As the first unit will treat only the lead carbonate ores there will be no zinc production until the other units are completed. Several articles[6] describing in detail the operations at Mount Isa have been published recently.

In September, 1930, reserves were reported[7] at nearly 30,600,000 tons, an increase of about 9,400,000 tons over estimates in November, 1928. The ore zone is about 2½ miles long and 1,500 feet wide, and has been developed to 750 feet in depth; diamond drilling indicates a continuation to the 1,000-foot level.

The American Smelting & Refining Co. is reported to have acquired a substantial interest in Mining Trust (Ltd.), which controls Mount Isa, and a 10-year contract for the technical management of the Mount Isa property.

The Mining Trust (Ltd.) has begun a drilling program at the Silver King mine[8] in the Lawn Hills Concession, Northern Queensland, 110 miles from Burketown. Ore has been developed to a depth of 200 feet over an area 600 feet by 60 feet. The ore is of the complex lead-silver-zinc type found at Mount Isa.

Tasmania.—The Electrolytic Zinc Co. of Australasia (Ltd.) made a record monthly production of 4,036 tons of zinc in September, 1929, at the Risdon plant.[9] This record was made without an increase in the number of cells, by close spacing of anodes and cathodes to permit more electrodes per cell and by improving current densities. Zinc was stripped at intervals of 72 hours instead of every 24 hours, as in American practice, thus lowering stripping costs and causing less wear on the cathodes.

This company has completed its experimental work on the treatment of complex lead, zinc, and silver sulphides of the Mount Read and Rosebery mines and is now constructing a mill at Rosebery. The 39,152 tons milled at the Zeehan pilot mill during the year ended June 30, 1929, averaged 21.7 per cent zinc, 5.9 per cent lead, 7.4 ounces silver, and 1.8 pennyweight gold. From this ore was produced 15,545 tons of zinc concentrates, averaging 50 per cent zinc, 5 per cent lead, 8.7 ounces silver, and 1.2 pennyweight gold, and 2,705 tons of lead concentrates, averaging 48.6 per cent lead, 17.4 per cent zinc, 44.5 ounces silver, and 8.2 pennyweight gold. The average of all reserves is about 24 per cent zinc, 7 per cent lead, 7½ ounces silver, and 2 pennyweight gold.

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[6] Mitke, C. A., Mining Methods at Mount Isa: Min. Mag., London, vol. 41, December, 1929, p. 329; Callow, J. M., The Mill and Smelter at Mount Isa: Min. Mag., London, vol. 41, December, 1929, p. 336; Mitke, C. A., The Mount Isa Project: Eng. and Min. Jour., vol. 128, Dec. 21, 1929, p. 954; Min. Mag., London, The Mount Isa Lead-Zinc Mines, North Queensland: Vol. 41, November, 1929, p. 265.

[7] Min. Mag., London, vol. 43, No. 3, September, 1930, p. 136.

[8] Eng. and Min. Jour., vol. 129, No. 10, May 23, 1930, p. 525.

[9] Eng. and Min. Jour., vol. 128, No. 20, Nov. 16, 1929, p. 787.

The North Mount Farrell property[10] in West Tasmania, near Tullah, has an ore body which is about 1,000 feet in length and averages about 8 feet in width, the ore containing 10 to 12 per cent lead, 8 to 10 per cent zinc, 14 ounces silver, and 10 per cent pyrite. Tailings, running 3 per cent lead and 11 per cent zinc, are being dumped into the zinc section of the mill for treatment. The zincky material is treated by flotation and yields concentrates which run 54 per cent zinc, 13 ounces silver, and 6 per cent lead. Lead concentrates average 60 per cent lead, 80 ounces silver, and 5 per cent zinc. The mill has a weekly capacity of 1,500 tons.

BELGIUM

The production of the Belgian zinc smelters in 1929 amounted to 201,380 metric tons, compared with 206,300 tons in 1928, largely from imported ores. In 1929 Belgium imported 610,194 tons of ore, compared with 564,312 tons in 1928; the ore in 1929 came from the following countries: Mexico 19 per cent, Italy 15 per cent, Australia 10 per cent, Sweden 10 per cent, Netherlands 9 per cent, India (British) 9 per cent, and others 28 per cent. Zinc ore exports amounted to 55,999 tons in 1929, compared with 46,334 tons in 1928; zinc slabs, ingots, and scrap exports totaled 71,549 tons in 1929, compared with 98,782 tons in 1928, and went to the following countries: Great Britain 28 per cent, France 24 per cent, Germany 19 per cent, Netherlands 5 per cent, and others 24 per cent. In addition, 62,683 tons of zinc sheets, wire, etc., were exported in 1929, compared with 56,088 tons in 1928. The calculated consumption of zinc in Belgium was about 136,800 tons in 1929, compared with 114,900 tons in 1928.

The largest producer of slab zinc in Belgium and the second largest in the world is the Société Anonyme de la Vieille Montagne. This company owns mines in many parts of the world and operates 3 zinc smelters in Belgium, 2 in France, and 1 in Germany. It also operates an electrolytic zinc plant in France. During 1929 the company produced 112,000 metric tons of zinc or 8 per cent of the world total, compared with 111,000 tons in 1928. During 1929 the company borrowed 150,000,000 francs on bonds for the purpose of improving plant efficiency and increasing the company's output. As circumstances become more favorable it is hoped that an annual output of 150,000 tons will be realized. Profits during 1929 did not justify the maintenance of the dividend rate established in 1928.

The Compagnie des Métaux d'Overpelt-Lommel et de Corphalie, another important zinc operator, produced 54,825 tons of ingot zinc, 12,060 tons of fabricated zinc, 50,540 tons of by-product 60° B. sulphuric acid, 12,950 tons of 66° B. acid, and other products during the fiscal year ended June 30, 1929. The low price of zinc, wage advances, and increased cost of fuel all contributed to the reduction of profits during the year.

CANADA

Mine production of zinc in 1929 amounted to 98,634 short tons, compared with 92,324 tons in 1928, an increase of 7 per cent. In 1929 87 per cent of the zinc was produced in British Columbia, 10 per cent in Quebec, and 3 per cent in Ontario, compared with 89 per cent in British Columbia, 11 per cent in Quebec, and a small quantity in Ontario in 1928. These production figures represent refined zinc made at Trail, and estimated recoverable zinc in ores and concentrates exported. The major part of the production came from the Sullivan mine in British Columbia. There have been important developments in the last few years in Manitoba, Quebec, and Ontario.

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[10] Min. Mag., London, vol. 43, No. 3, September, 1930, pp. 180–182.

British Columbia.—By far the largest part of the zinc output of British Columbia comes from the Fort Steele district. The following table shows the recoverable zinc produced in 1928 and 1929, by districts.

Recoverable zinc produced in British Columbia, 1928 and 1929, by districts, in pounds

District	1928	1929
Fort Steele	167, 842, 300	162, 904, 853
Slocan	8, 735, 009	4, 510, 802
Ainsworth	3, 662, 363	4, 050, 901
Omineca	788, 253	482, 731
All others	735, 222	147, 554
	181, 763, 147	172, 096, 841

Practically all of the Fort Steele district output comes from the Sullivan mine of the Consolidated Mining & Smelting Co. of Canada (Ltd.). The zinc production of the district was 3 per cent less than in 1928, because of decreased production at the Sullivan property.

The Sullivan mill treated an average of about 5,000 tons of ore daily during the last nine months of 1929 (more than 1,000 tons above the 1928 average), but the output of metals was less because of the lower grade of the ore treated. The treatment of lower-grade ore, made possible by enlargement of the mill, has led to an increase of nearly 1,500,000 tons in ore reserves. The enlargement of the Kimberley mill to a daily capacity of 6,000 tons of ore was about 80 per cent completed at the end of the year. The Sullivan mine had produced about 10,178,000 tons of ore to the end of 1929; mining during the latter part of 1929 was at the rate of nearly 2,000,000 tons per year. Reserves were estimated at 30 to 50 years. However, recent drilling has disclosed that the ore body continues at workable grade to 1,000 feet below the present working tunnel or to 4,900 feet in depth, indicating that the life of the mine will exceed previous estimates.

In addition to the Sullivan mine the Consolidated Mining & Smelting Co. operates several reduction plants at Trail and Tadanac where its own and custom ores are treated. The total metal production of this company in 1928 and 1929 and from 1894 to 1929 is shown in the following table.

Ore and metals produced by the Consolidated Mining & Smelting Co., 1928 and 1929 and 1894–1929

	1928	1929	1894–1929
Ore treated short tons	1.665, 586	(1)	(1)
Gold ounces	23, 623	14, 694	2, 202, 733
Silver do	7, 673, 762	7, 362, 164	76, 726, 300
Copper pounds	17, 806, 306	8, 346, 632	168, 887, 956
Lead do	318, 831, 578	300, 433, 924	2, 388, 464, 397
Zinc do	163, 530, 890	172, 096, 841	1, 045, 519, 718
Cadmium do	491, 894	773, 976	(1)

[1] Data not available.

In addition, bismuth and by-product sulphuric acid were produced in 1929 for the first time.

A new 35-ton contact sulphuric acid plant at Tadanac was completed and put into operation during 1929. The new equipment is treating zinc roaster gases and has worked so successfully that it is planned to enlarge the plant to a daily capacity of 360 tons.

A new zinc fuming plant[11] to cost $2,500,000 was to be placed in operation by August, 1930. The plant is expected to recover 100 tons of lead and zinc daily from lead blast-furnace slag, which is heated electrically in rectangular, water-jacketed furnaces. Coal dust is blown into the molten mass and reduces the lead and zinc to the metallic stage. The metals are then volatilized and oxidized, and the fumes are collected in Cottrell plants. There is said to be sufficient waste heat from the operation to supply the Trail smelter with process steam. The fumes are leached with sulphuric acid, which removes the zinc; the lead and silver in the residue are recovered at the lead smelter. The zinc sulphate solution is purified and neutralized, and the zinc is recovered electrolytically. The company has a large quantity of lead blast-furnace slag which runs about 15 to 20 per cent zinc. The high zinc content is due to the treatment of zinc ferrites and ferrates from the leaching plant in the blast furnace.

The production of zinc in the Slocan district decreased 48 per cent during 1929, owing to the low price of metals. Mining costs are relatively high in this district because operations are on a small scale. Production is not expected to increase until there is a substantial rise in metal prices.[12]

The principal operator in the Ainsworth district was the Whitewater Mines (Ltd.), which produced about 5,000 tons of concentrates containing more than 3,000,000 pounds of zinc in addition to gold, silver, and lead. The concentrates were shipped to the Trail smelter. Milling operations were suspended at the end of July owing to low metal prices.[13]

At the Reeves-McDonald[13] property in the Nelson mining district 2,000,000 tons of low-grade zinc-lead ore have been blocked out. It was originally planned to treat this ore in the 2,000-ton concentrator and the electrolytic zinc plant which the Pend Oreille Co. plans to erect in the State of Washington, but the extension of the United States tariff to cover ores containing less than 10 per cent zinc will probably result in revision of this plan. The mine can not be operated profitably at present prices.

Along the Tulsequah River two large complex ore bodies have been opened, one at the Tulsequah Chief (controlled by United Eastern Mining Co.) and the other on the Manville group (Alaska Juneau Gold Mining Co.). The former shows 120,000 tons of ore containing 6 per cent zinc, 0.6 per cent lead, 1.75 per cent copper, and 3.5 ounces silver and 0.1 ounce gold per ton. The average metal contents reported for the Manville group at the time of examination was as follows: Zinc, 15 per cent; lead, 1 per cent; copper, 2 per cent; and silver and gold, 6 ounces and 0.12 ounce per ton, respectively.

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[11] Canadian Mining Journal, Sept. 12, 1930, p. 902.
[12] British Columbia, Minister of Mines, Annual Report for the year ended Dec. 31, 1929, Victoria, 1930
[13] Min. Jour., London, vol. 168, No. 4927, Jan. 25, 1930, Annual Review Section, p. (23).

The Base Metals Mining Corporation[14] recently completed a 300-ton mill and has a large body of ore running 30 to 35 per cent combined zinc and lead and 2 ounces silver. The mill heads have been averaging 16 to 17 per cent combined lead and zinc, but the company plans to increase the grade treated to about 26 per cent. The lead concentrates run about 72 per cent lead, whereas the zinc concentrates average about 52 per cent zinc, with a high rate of recovery. The concentrates are now being shipped to a foreign smelting works. Present plans call for the enlargement of the mill to 500, possibly 1,000, tons daily capacity. The reserves are estimated at 400,000 tons.

Quebec.—Quebec was the second largest producer of zinc in the Dominion during 1929, producing 9,824 short tons. The entire output was from the Tétreault mine at Notre Dame des Anges, which was closed in December, 1929, and returned to the Tétreault estate before the termination of the lease. The estate expects to develop the mine later for further production.

The Waite-Ackerman-Montgomery mine[15] at Rouyn mined and shipped to the Noranda smelter 45,768 tons of ore and concentrates averaging 8.13 per cent copper, 4.9 per cent zinc, 2.12 ounces silver, and 0.05 ounce gold. This material was smelted in a copper furnace and the zinc content was slagged off. On December 31, 1929, reserves were estimated at 100,000 tons of copper ore averaging 6.1 per cent copper and 3.3 per cent zinc and 300,000 tons of zinc ore averaging 11.5 per cent zinc.

The Amulet concentrator,[16] which has a daily capacity of 300 tons, came into production early in 1930. Construction of a railway spur to the mine has nearly been completed. The production of copper and zinc concentrates is expected in 1930.

Abana Mines (Ltd.)[17] is to build a 250-ton mill. Reserves are estimated at 399,500 tons of copper ore averaging 4.7 per cent copper, 7 per cent zinc, 4 ounces silver, and 0.5 ounce gold and 538,400 tons of zinc ore containing 18 per cent zinc and 0.8 per cent copper, a total of about 937,900 tons averaging 2.7 per cent copper, 13.2 per cent zinc, and 4.87 ounces silver. First operations will be confined to copper ore, the zinc concentrates being stored until a local market is obtained.

Early in 1930, J. J. Warren, president of the Consolidated Mining & Smelting Co., stated that the company had purchased a tract of land on Isle Perrot at the junction of the Ottawa and St. Lawrence Rivers, where it was planned to erect an electrolytic zinc plant estimated to cost $5,000,000. Power will be obtained from the Beauharnois power project near by, and the capacity is expected to exceed that of the Trail plant. It was reported also that Ventures (Ltd.), which has a plant at Sudbury, will be associated with the project.

Materials will be drawn from the mines in the Rouyn, Sudbury, and northern Manitoba regions. Isle Perrot is near the island of Montreal and is on the double-track main line of the Canadian Pacific and Canadian National Railways. The waters of the Ottawa and St. Lawrence Rivers will furnish additional transportation both from producing and to consuming centers. This refinery will save transportation costs to Wales and Norway, where much of the work is done at present. A sulphuric acid plant has also been proposed to remove the injurious gases from the fumes.

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[14] Mason F. H., Review of Mining in British Columbia in 1929; Canadian Min. Jour., vol. 51, No. 1, 1930, pp. 8-10.

[15] Eng. and Min. Jour., vol. 129, No. 5, May 8, 1930, p. 265.

[16] Min. Jour., London, vol. 169, No. 4940, Apr. 26, 1930, p. 329.

[17] Eng. and Min. Jour., vol. 130, No. 2, July 24, 1930, p. 96.

It was also reported[18] that the Robertson Lead Manufacturing Co. (Ltd.), a subsidiary of James Robertson & Co. (Ltd.), had purchased 140,000 feet of land at Montreal on which it will erect a plant for processing lead and zinc.

Manitoba.—Preparations for production at the Flin Flon and Sheritt-Gordon projects continued during 1929.

The Flin Flon is a copper-zinc mine which is reported to have reserves[19] amounting to about 18,000,000 tons of concentrating ores containing about 1.71 per cent copper, 3.45 per cent zinc, 0.074 ounce gold, and 1.06 ounces silver. In addition, diamond drilling[20] has disclosed a new zinc-copper ore body 500 feet from previously known ore, indicating an extension of the main deposit. Up to April, 1930, the project had cost nearly $21,000,000, and plans call for a further expenditure of about $10,000,000. Production will be at the rate of 3,000 tons daily, 1,000 tons of which will be obtained from underground and 2,000 tons from open-pit operations. The open-pit work will extend over a length of 1,500 feet and to a depth of 300 feet, below which underground mining will be used.

In May, 1930, it was stated[21] that profits were estimated at $2 to $2.25 per ton with zinc at 3½ cents and copper at 13 cents per pound and silver at 40 cents per ounce. Production was expected the latter part of 1930.

Sherritt-Gordon has a reserve of 5,255,000 tons of ore[22] averaging 2.75 per cent copper, 3.39 per cent zinc, 37 cents in gold, and 45 cents in silver. Construction of a mill of 1,800 tons daily capacity was well under way in June, 1930. The copper concentrates are to be smelted at the Flin Flon smelter, and the zinc concentrates will probably be treated at the proposed smelter at Montreal. It has been reported that the Consolidated Mining & Smelting Co. has obtained a substantial interest in the property.

The Mandy mine, 4 miles southeast of Flin Flon, is said[23] to have 100,000 tons of ore averaging about 5 per cent copper and 17 per cent zinc ready to be mined as soon as a smelter is built locally. Early in 1929 the shaft had been sunk to 1,025 feet, and development work will be instituted to determine whether the ore found in the upper levels extends downward.

Ontario.—According to the Dominion Bureau of Statistics Ontario produced 2,758 short tons of zinc in 1929, practically all of which was derived from the Errington mine of the Treadwell Yukon Mining Co., which operated its experimental flotation plant throughout the year. Progress was made in the treatment of the ores. Recoveries averaged 73 per cent in 1929 and were distributed as follows:

	Per cent recovery		Per cent recovery
Zinc	80	Silver	50
Copper	70	Gold	50
Lead	60		
		Average	73

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[18] American Metal Market, May 29, 1930, p. 5.
[19] Eng. and Min. Jour., vol. 128, No. 14, Oct. 5, 1929, p. 560.
[20] Eng. and Min. Jour., vol. 129, No. 8, Apr. 24, 1930, p. 425.
[21] Wall Street Journal, May 26, 1930, p. 11.
[22] Min. Jour., London, vol. 167, No. 4921, Dec. 14, 1929, p. 991.
[23] Eng. and Min. Jour., vol. 124, No. 8, Aug. 20, 1927, p. 302.

It is hoped that further experimental work during 1930 will raise the over-all recovery to 80 per cent. The average grade of the 89,221 tons of material treated in 1929 was 4.49 per cent zinc, 0.98 per cent lead, 1.04 per cent copper, 1.64 ounces silver, and 0.028 ounce gold. Diamond drilling[24] in the No. 2 shaft area indicated the projection of the 500-level ore body down to the 1,500 level, and as a result the shaft will be sunk to that depth and development work begun to verify diamond-drill results. Should this work prove the existence of as large an ore body on the 1,500 level as is now developed on the 500 level a reserve of about 7,300,000 tons would be indicated between the 500 and the 1,500 levels. The developed reserves to date are estimated to contain about 1.65 ounces silver, 0.03 ounce gold, 1 per cent lead, 1.05 per cent copper, and 4.55 per cent zinc. Ore developed during 1929 averaged slightly less. Should this development work prove a paying project the company plans to erect a new 2,000-ton selective flotation plant.

Development was continued at the Sudbury Basin Mines (Ltd.) property,[25] which adjoins the Errington, and 833,000 tons of ore have been proved. Exploitation of this property is awaiting results at the Errington mine.

The Sudbury Contact mine, which adjoins the Sudbury Basin mine on the south, did a little development work during 1929 and plans more extensive operations in 1930.

Nova Scotia.—The Stirling mine[26] is the most important metalliferous mine in the Province. It contains a complex zinc-copper-lead ore. The property was acquired in 1927 by the British Metals Corporation of Canada. Considerable ore has been developed down to the 400-foot level, and a mill of 250 tons capacity has been built and was to have been operating early in 1930. Information on the grade and amount of the reserves is not available, although in December, 1928, 200,000 tons of ore was estimated down to 200 feet.

Northwest Territories.—Interesting advances have been made in the Great Slave Lake district by the Northern Lead-Zinc Co., which is owned by Consolidated Mining & Smelting Co., Ventures (Ltd.), Atlas Mining Co., and a Boston syndicate. Development work has disclosed several masses of ore in crystalline dolomites, the largest being 900 by 200 feet and the smallest 125 by 80 feet, with a thickness ranging to 55 feet. Ore in a 55-foot test shaft averaged 22.3 per cent lead and 13.6 per cent zinc. The area appears promising, and an extensive diamond-drilling program is now progressing. Transportation facilities are very inadequate at present, and improvements will wait the developments in the field.

FRANCE

France produced 91,600 metric tons of zinc in 1929, compared to 96,873 tons in 1928. Consumption of zinc in France in 1929 was estimated at 113,700 tons. The smelting industry depends largely on foreign ore; in 1929, 216,525 tons of ore were imported, Spain supplying 24 per cent, Mexico 23 per cent, Italy 16 per cent, and others 37 per cent. Imports of pigs, bars, slabs, etc., amounted to 33,792 tons in 1929, compared with 42,513 tons in 1928. Belgium supplied 62 per cent of the 1929 imports. Exports of slab zinc in 1929 amounted to 11,661 tons, as compared to 13,645 tons in 1928.

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[24] Canadian Min. Jour., vol. 51, No. 17, Apr. 25, 1930, p. 400.
[25] Canadian Min. Jour., vol. 51, No. 12, Mar. 21, 1930, p. 280.
[26] Min. Jour., London, Mining in Nova Scotia: Vol. 170, No. 4955, Aug. 9, 1930, p. 638.

France produces only a small percentage of its ore requirements. The Departments of Gard, Hérault, Brittany, and the Pyrenees are the principal sources. The ores are largely from isolated veins of galena, blende, and calamine and from the complex low-grade ores of Villemagne and Saint Sebastien-d'Aigrefeuille. Operations at Villemagne in 1929 resulted in a loss of over 4,000,000 francs including depreciation. About 144,000 tons of ore were produced, of which 132,900 tons were treated. During the first 4 months of 1930, 49,000 tons were treated, which yielded 3,634 tons of zinc and 1,553 tons of lead. It was reported that this operation was conducted without loss. The mill has been increased to 450 tons daily. Saint Sebastien has yet to do considerable development work before its possibilities can be evaluated. The same condition exists at the Arrens mine in the Basses Pyrenées.

GERMANY

Germany produced 105,326 metric tons of zinc during 1929, as compared with 104,707 tons in 1928, an increase of less than 1 per cent. The mine production (zinc content of ores, etc.) amounted to 142,000 tons, as compared to 144,000 tons in 1928; the larger part came from Upper Silesia. German imports of slab zinc amounted to 136,207 tons, as compared with 143,233 tons in 1928, a decrease of 5 per cent. Poland supplied 52 per cent of the 1929 imports, Belgium 18 per cent, United States 6 per cent, and Australia 5 per cent. Exports of slab zinc amounted to 38,008 tons in 1929, compared with 37,011 tons in 1928. Consumption amounted to about 200,000 tons in 1929, compared with 204,300 tons in 1928. It has been estimated that in 1929 the brass makers took 70,000 tons, rolling mills 70,000 tons, galvanizing 35,000 tons, and the chemical and dye industries 25,000 tons. Germany imports and exports large quantities of zinc ore. Imports of ore were 179,000 tons in 1929, as compared to 163,000 tons in 1928. Mexico supplied 30 per cent of the imports in 1929, Russia 9 per cent, Italy 9 per cent, Sweden 6 per cent, Greece 6 per cent, Australia 5 per cent, and others 35 per cent.

Exports amounted to 180,000 tons in 1929, as compared to 202,000 tons in 1928. Poland took 77 per cent of the 1929 export. This export of ore is due largely to the lack of zinc-smelting facilities in German Upper Silesia.

Low prices reacted unfavorably on many of the zinc-mining companies in Germany. The Stolberg Co., the largest zinc-mining company in Germany, planned to erect an electrolytic zinc plant, but during the latter part of the year it was announced that the plan had been postponed. In January, 1930, this company was asking permission to close down the Holzappel lead-zinc mine. Apparently the German smelters were suffering from competition of foreign zinc producers in the German market. This led to an agitation for a tariff of £3 per ton when zinc was selling below £22. According to the Daily Metal Reporter[27] the following outputs were made by the six German zinc-producing concerns in 1928 and 1929.

Zinc produced by six German firms, 1928 and 1929, in metric tons

Firm	1928	1929
Zu Stolberg, A.G	22,249	23,660
Zink Industrie (Hamborn), A.G	9,862	9,936
Soc. Vieille Montagne (Borbeck)	12,138	[1] 13,728
Berzelius Metallhütten, A.G. (Bensberg)	29,934	[2] 34,948
Metallwerke Unterweser (Nordenham)	11,392	[3] 13,281
Zinkhütte (Hamburg)	12,813	[4] 9,769
	98,388	105,322

[1] Belgian capital.
[2] Metallgesellschaft Co.
[3] Beer, Sondheimer & Co.
[4] Aron Hirsch & Sohn.

The Giesche concern has plans for an electrolytic zinc plant at Magdeburg capable of producing 60,000 tons of zinc annually. The plant is expected to be operating in 1931.

GREAT BRITAIN

Great Britain ranked third in consumption and seventh in production in 1929. Consumption amounted to approximately 190,000 metric tons or 13 per cent of the world total, while production amounted to only 59,000 tons or 4 per cent of the world total. Great Britain's zinc-smelting industry depends almost entirely on foreign ores, the 1929 mine output having been reported as 864 tons of zinc.

Imports of slab zinc in 1929 amounted to nearly 145,000 metric tons, an increase of 5 per cent over 1928. Belgium and Germany were the principal sources, having contributed 30 per cent and 24 per cent, respectively.

The expected expiration in 1930 of the British Board of Trade contract, under which Broken Hill zinc concentrates were purchased at a price considerably above the open market, resulted in reorganization of the Empire's zinc mines and smelters. The Imperial Smelting Corporation (Ltd.) was organized in August, 1929, to take over the control of the National Smelting Co. (Ltd.), which owned 4,000,000 ordinary shares of Burma Corporation (Ltd.) and smelting works at Avonmouth and Llansamlet, South Wales, capable of handling 100,000 tons of concentrates annually and producing 30,000 tons of zinc and 100,000 tons of sulphuric acid. The smelting works are being extended and the erection of a copper smelter and refinery is being considered. It was reported that the Burma Corporation, North Broken Hill, Broken Hill South, and the Zinc Corporation were participating in the reorganization. The last three companies are among the largest producers in the Broken Hill district. Zinc concentrates in excess of what will be needed by the Risdon plant of the Electrolytic Zinc Co. of Australasia (Ltd.), which is controlled by the Broken Hill mining companies, will be taken by the Imperial Smelting Corporation. The Sulphide Corporation, one of the four largest producers at Broken Hill, operates its own smelter at Seaton Carew, England.

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[27] Daily Metal Reporter, vol. 30, pt. 2, No. 119, June 20, 1930, p. 15.

British firms exported 711,700 tons of galvanized sheets, as compared to 718,033 tons in 1928, the decrease being due to a drop from 274,545 to 240,117 tons in the amount taken by British India.

The Zinc Manufacturing Co., which owns the patents covering the Coley process, has obtained patents in all important countries. Six units have been erected at Dartford, and 12 units are being installed in Tunisia.

Chemical and Metallurgical Corporation (Ltd.) [28] plans an electrolytic zinc plant in England for the treatment of zinc residues from zinc-lead ore.

INDIA

The Burma Corporation (Ltd.) is one of the world's important lead-zinc-silver producers, and the only producer of any consequence in India. Its mines are at Bawdwin in the Upper Shan States of Burma. During the year ended June 30, 1929, the company mined 463,057 long tons of ore which averaged 22.6 per cent lead, 12.9 per cent zinc, 1.07 per cent copper, and 19.7 ounces of silver, and brought the total ore mined from the start of operations to 3,115,518 tons. The metal output for the fiscal year was 78,716 tons of refined lead, 7,376,841 ounces of refined silver, 60,180 tons of 51.81 per cent zinc concentrates, 1,227 tons of refined antimonial lead, and 10,719 tons of copper matte. Only 57 per cent of the zinc in the ore treated was recovered in the zinc concentrates owing to the refractory nature of the ore. Ore reserves as of June 30, 1929, were estimated at 4,149,263 tons averaging 25.8 per cent lead, 15.7 per cent zinc, 21.2 ounces silver, and 1.05 per cent copper.

Some very high-grade ore was found at depth in the Shan ore body; on the eighth level 12.5 feet of ore averaging 47.8 per cent lead, 13 per cent zinc, and 35 ounces silver was struck, while on the ninth level 61.3 feet of ore averaging 33 per cent lead, 9.5 per cent zinc, and 24 ounces silver was penetrated. The tenth level showed nearly 38 feet of ore containing 19.7 per cent lead, 16.2 ounces silver, and 18.5 per cent zinc. The mill is being extended to a capacity of 45,000 tons monthly.

INDO-CHINA

French Indo-China produces a substantial quantity of zinc ore, but the output has declined during the last few years. In 1929 ore containing 18,760 metric tons of zinc was produced, as compared with 21,486 tons in 1928 and about 25,000 tons in 1926. The 1929 output was derived from only two mines. The principal producer is the Société Minière et Métallurgique de l'Indochine. This company produced 35,000 tons of calamine ore and smelted 3,808 tons of zinc at its smelter at Quang-Yen.

ITALY

The mines of Italy in 1929 produced ore containing about 80,000 metric tons of zinc as compared to 85,000 tons in 1928, a decrease of 6 per cent. Smelter production, however, increased from 10,654 tons in 1928 to 15,804 tons in 1929, all of which was due to the increased output at Italy's three electrolytic zinc plants.

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[28] Min. Jour., London, vol. 165, No. 4891, May 18, 1929, p. VII.

In terms of ore the 1929 output amounted to 189,000 tons, as compared to 220,000 tons in 1928. Exports of zinc ore in 1929 amounted to about 162,000 tons, of which Belgium took 66 per cent, France 19 per cent, and others 15 per cent.

The principal zinc producers in Italy are the Società di Monteponi and the Società di Pertusola, both of which operate large mines in the Iglesias district on the island of Sardinia. This district contributes by far the largest part of the Italian mine production of lead and zinc. The Province of Trieste ranks second. The Società di Monteponi operates an electrolytic zinc plant at Monteponi, Sardinia, and a smelter at Vado, Ligure, Genova, and produced about two-thirds of the Italian metallic zinc production in 1929.

The Società di Pertusola operates an electrolytic zinc plant at Cotrone and plans the erection of a new furnace for the production of zinc oxide at its San Giovanni mine in Sardinia. A third electrolytic zinc plant is operated by the Società Elettro-Mineraria at San Dalmazzo di Tenda.

Italy imports some slab zinc to meet its own demands. In 1929, 8,322 tons of slab and scrap zinc was imported, as compared with 10,509 tons in 1928. In addition about 4,500 tons of plates and sheets is imported annually.

JAPAN

Japan consumes a large quantity of zinc, most of which is supplied from imported ores and metal. The estimated consumption in 1929 was 50,100 metric tons, a decrease of 9 per cent from 1928. The 1929 smelter output has been estimated at 23,000 metric tons and the mine output at 10,000 tons.

Imports of slab zinc amounted to 27,111 tons in 1929, a decrease of 24 per cent from 1928. Canada supplied 43 per cent of the 1929 imports, Australia 35 per cent, and United States 8 per cent. Imports from the United States decreased from 8,889 tons in 1928 to 2,264 tons in 1929. Imports of zinc ore amounted to 28,500 tons in 1929 and 21,000 in 1928. China, Chosen, and Mexico are the principal sources of zinc-ore imports.

The principal use of zinc in Japan is in the galvanizing industry, which takes 75 per cent of the total. The brass industry ranks second.

MEXICO

The smelter production of zinc in Mexico during 1929 amounted to 15,099 metric tons, compared to 11,220 tons in 1928, an increase of 35 per cent. Mine production amounted to 174,000 metric tons of zinc in 1929, as compared with 161,747 tons in 1928. This increase was made notwithstanding a short interruption of mining operations by revolution in March and April and a drought in some areas which forced certain properties to curtail operations.

Details of the 1929 mine production are not available. The following data are for 1928. Of the 161,747 metric tons of zinc produced in that year 6.5 per cent was in the form of slab zinc, 83.8 per cent in concentrates, 8.7 per cent in calcines, and 1 per cent in crude ore. The State of Chihuahua produced 56 per cent of the total, Zacatecas 15 per cent, San Luis Potosi 13 per cent, and Coahuila 7 per cent. No other State produced over 3 per cent of the Mexican total. The principal districts were Santa Barbara, Chihuahua, 22 per cent; Hidalgo del Parral, Chihuahua, 14 per cent; Charcas, San Luis Potosi, 13 per cent; Santa Eulalia, Chihuahua, 11 per cent; Sierra Mojada, Coahuila, 7 per cent; Guerrero, Chihuahua, 8 per cent; and Mazapil, Zacatecas, 5 per cent. No other district produced over 3 per cent of the total.

Exports of zinc in all forms amounted to 160,894 tons in 1928, as compared to 135,529 tons in 1927. Belgium took 50 per cent of the 1928 exports, Germany 19 per cent, France 12 per cent, United States 11 per cent, and Great Britain 6 per cent.

NETHERLANDS

The zinc-smelting industry in the Netherlands is supported entirely by foreign ores, of which 78,000 metric tons were imported in 1929 and 97,000 tons in 1928. Most of the ore is imported through Belgium. In 1929, 25,712 metric tons of slab zinc were produced in the Netherlands, as compared with 26,857 in 1928, a decrease of 4 per cent. A large part of the zinc smelted in the Netherlands is exported. Exports amounted to 22,594 tons in 1929 as compared to 27,094 tons in 1928.

NEWFOUNDLAND

The Buchans mine,[29] owned by the Anglo-Newfoundland Development Co. and operated by the American Smelting & Refining Co., mined and milled 166,536 long tons of ore and produced 73,508 dry tons of concentrates during the fiscal year ended November 30, 1929. Plans for 1930 call for the doubling of the daily mill capacity to nearly 1,000 tons. Ore reserves on December 1, 1929, were quoted at 7,159,464 tons, averaging about 0.04 ounce gold, 3.64 ounces silver, 1.13 per cent copper, 7.28 per cent lead, and 16.27 per cent zinc. The territory to the east and west of Buchans has been covered rather thoroughly by electrical prospecting methods, and similar work is contemplated on an area to the south at Red Indian Lake, where geological conditions are believed to be favorable.

NEW ZEALAND

The Waiomo Sulphide Co.[30] is constructing a 50-ton selective flotation mill to treat complex gold, silver, copper, lead, and zinc sulphide ores. Minerals Separation and De Bavay's units will be used. An aerial tram is also being built to connect the mine and the mill.

NORWAY

Norway produced 5,516 metric tons of slab zinc in 1929, some of which was obtained from the smelting of secondary materials. An increased output of primary zinc is expected in 1930 as a result of the completion of the first unit of the electrolytic zinc plant of the Norske Zink Kompani[31] near Odda, which has a daily capacity of 35 tons. If market conditions are satisfactory, the plant will be increased to 100 tons capacity. The plant probably handles imported ores.

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[29] Min. Jour., London, vol. 168, No. 4930, Feb. 15, 1930, p. 133.
[30] Min. Jour., London, vol. 164, No. 4884, Mar. 30, 1929, p. 244.
[31] Daily Metal Reporter, vol. 30, pt. 2, Jan. 21 1930, p. 15.

Norwegian capitalists are reported to be investigating the low-grade zinc ores which occur along the northwestern coast. The mine production of zinc in Norway was negligible up to 1929, but in that year showed a marked increase. It remains to be seen whether conditions will warrant continuance of this expansion.

PERU

The production of zinc ore in Peru increased in 1929 owing to the increased output of the Cerro de Pasco Copper Corporation, the principal operator. This company began construction of a new lead-zinc concentrator designed to replace the old one at Casapalca. The new plant is expected to produce early in 1931. A new 25-ton pilot mill for the treatment of the Cerro de Pasco lead-zinc ores should be in operation early in 1930.

The Northern Peru Mining & Smelting Co.[32] has purchased the Chilete lead-zinc mine near Pascasmayo.

POLAND

Poland ranked third in smelter production of zinc in 1929, having produced 169,029 metric tons as compared with 161,815 tons in 1928. A large part of the Polish smelter output is derived from ores mined in Upper Silesia, as can be seen from the following table which shows the crude-ore production[33] of Poland by districts in 1928 and 1929.

Zinc-lead ore produced in Poland, 1928 and 1929, by districts

District	Number of mines operating	Ore produced (metric tons)	
		1928	1929
Kielce	4	71, 950	76, 245
Cracow	2	64, 635	99, 680
Upper Silesia	6	974, 460	956, 780
	12	1, 111, 045	1, 132, 705

Poland also imports large quantities of zinc ore, chiefly from German Upper Silesia. Imports of ore amounted to 196,735 tons in 1929 and 191,113 tons in 1928. A large part of the zinc smelted in Poland is exported. Exports of slab zinc totaled 132,505 tons in 1929 and 124,935 tons in 1928. Germany took 56 per cent of the 1929 export, Russia 15 per cent, and Czechoslovakia 12 per cent. In addition, 7,861 tons of zinc dust and 14,189 tons of zinc sheets were exported in 1929.

The largest zinc producer in Poland is Giesche Spólka Akcyjna. This concern produced 69,829 metric tons of zinc in 1929, as compared to 60,540 tons in 1928. Its zinc smelters are at Rozdzien-Szopienice and Trzebinia; the former was being closed down in June, 1930. The company also operates an electrolytic zinc plant at Szopienice that can produce 60 tons of zinc daily. The plant produced over 13,000 metric tons in 1929.

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[32] Eng. and Min. Jour., vol, 129, No. 3, Feb. 8, 1930, p. 145.

[33] Metal Bull., July 11, 1930, p. 8.

Schlesische A. G. für Bergbau und Zinkhüttenbetrieb (Slaskie Kopalnie i Cynkownie, Spólka Akcyjna) ranks second in Polish zinc production. This company produced 61,456 metric tons in 1929 and 57,646 tons in 1928. Both figures include zinc dust. The company operates 5 zinc smelters in Poland, with a combined capacity of 64,000 metric tons of zinc annually. In addition, the company began operating an electrolytic zinc plant in June, 1930. The plant is at Kamien and has an annual capacity of 8,000 tons of zinc.

RHODESIA (NORTHERN)

The Rhodesia Broken Hill Development Co. produced 12,121 long tons of electrolytic zinc in 1929, compared with 9,579 tons in 1928. This zinc was obtained from the following materials:

Materials consumed by Rhodesia Broken Hill Development Co. in production of electrolytic zinc, 1928 and 1929

Kind of material	1928		1929	
	Long tons	Zinc content (per cent)	Long tons	Zinc content (per cent)
Zinc silicate ores	33, 908	28. 2	50, 728	27. 5
Mill dump tailings	3, 363	36. 0	353	27. 1
Calcines	9, 106	50. 77	8, 035	52. 63
Slag	865	18. 4	783	16. 00
Blue powder (imported)	17	100. 00	----------	----------
Zinc in H_2SO_4 consumed	28	----------	21	----------
	47, 287	----------	59, 920	----------

Recoveries amounted to 72.17 per cent in 1929 and 70.86 per cent in 1928. The plant was producing at the rate of 20,000 tons annually during August, 1930, and at nearly 80 per cent recovery. A recovery of 85 per cent is expected when the vanadium plant is in operation. Improvement was also made in the consumption of acid. It was originally estimated that 2.5 tons of zinc would be produced per ton of acid. This was not realized in the first year of operation, but in May, 1930, nearly 3 tons of zinc were produced per ton of acid. Cost of production was reported at £12 per ton or 2.6 cents per pound.

Reserves as of December 31, 1929, were quoted at 1,612,000 tons, as compared to 1,079,383 tons on December 31, 1928, an increase of 532,617 tons during the year.

Production of lead was suspended in July, 1929, owing to exhaustion of lead-zinc sulphide ore bodies in the developed section above the 225-foot level. A large undeveloped reserve is known to exist below the 225-foot level. A new plant for the production of vanadium oxide will be completed by January, 1931.

The geological and mineralogical features of the deposit have been described in the Mining Magazine, London.[34]

RUSSIA

The American Bureau of Metal Statistics estimates the consumption of zinc in Russia in 1929 at 38,000 metric tons, a slight increase over 1928. Since only 4,400 tons were produced large imports were required. During the fiscal year ended September 30, 1929, 34,711 tons of zinc were imported, approximately 60 per cent coming from Poland.

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[34] Min. Mag. ,London, vol. 42, No. 1, January, 1930, p. 47.

There have been many conflicting reports and frequent changes in the Soviet plans for increasing metal production. The latest information regarding the development of zinc production appears in an article[35] by a member of the Technical Bureau, Nonferrous Metal Industry, Union of Socialist Soviet Republics. According to this authority the Soviet Government plans the construction of the following plants capable of producing 135,000 metric tons of zinc annually.

Plant	Present annual capacity for concentrates (metric tons)	Planned annual capacity for pure metal (metric tons)
Ridder electrolytic zinc plant (Altai). Only concentrates now being produced	16, 000	25, 000
Alagir electrolytic and distillation zinc plant (North Caucasus)	4, 000	10, 000
Cheliabinsk electrolytic zinc plant, Central Urals		20, 000
Kemerovo electrolytic zinc plant, western Siberia, Kuzbas region		60, 000
Konstantinovka distillation zinc plant, near Kharkov		20, 000
	20, 000	135, 000

Of the plants named the only old one is the Alagir distillation plant. All of the others are of new construction. The first unit of the Ridder plant is complete and has been in operation two years. A second unit is being constructed. The Konstantinovka plant is being completed and should be operating by the end of 1930. The Cheliabinsk and Kemerovo plants are being designed, and construction should start before the end of 1930.

The Lena Goldfields (Ltd.) became involved in a dispute with the Soviet authorities, which finally led to the annulment of their concessions on mineral properties in various parts of Russia, which included lead-zinc-silver deposits in the Altai district. This situation was well summarized in a recent edition[36] of the Economist, a London publication.

> For an adequate appreciation of the situation leading up to the final collapse of this important mining concession, it is necessary to hark back to 1921, when Lenin introduced the new economic policy into Russia, and so put an end to the active revolutionary era and the period of "war communism." In that year it became apparent that the available capital resources of the U. S. S. R. were likely to prove wholly insufficient to repair the ravages of the revolution and the civil wars, and to set Soviet national economy on a sound financial and technical footing. The introduction of "N. E. P." was consequently accompanied by the resuscitation of private enterprise in the distributive and other trades, and to some extent in industry, and by the launching of a new scheme whereby foreign capitalists would be offered "concessions" on Soviet territory, and would be asked to develop certain branches of the Soviet economy—particularly manufactures, mining, and agriculture—on terms which provided for the division of profits between Government and concessionaire in agreed proportions, and which undertook to secure for foreign enterprise privileged conditions of working as compared with state-owned enterprises.

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[35] Karmashov, V., Nonferrous Metal Industry of Soviet Russia: Eng. and Min. Jour., vol. 130, July 24, 1930, p. 67.

[36] The Economist, London, The Lena Case: Vol. 140, Sept. 6, 1930, p. 432.

In pursuance of this policy, a concession agreement was signed in November, 1925, between the Soviet Government and Lena Goldfields (Ltd.), a company which united the former owners of Lena Goldfields of Siberia and a number of enterprises interested in the former Sysert mining district and the South Altai mixed ore deposits of southern Siberia. By this agreement the company was granted the concessionary right to enterprises in the gold mining and subsidiary industries for a duration of thirty years in the Lena-Vitim district and for a duration of fifty years in the Ural-South Altai district. Relations between the company and the Government continued on fairly amicable lines until the latter part of 1928, when, before Lena had had occasion to voice any strong discontent, the Soviet Government apparently began to protest that certain provisions of the concession agreement—the provision of capital for prospecting in the Altai, the smelting of copper in the Degtiar copper foundry, the construction of mines and works, the production of gold in the Lena-Vitim area according to plan, and the payment of agreed deductions from the output of the various enterprises—had not been fulfilled. The company retorted that the Government, on its part, had violated both the spirit and the letter of its concession obligations, in that it had failed to transfer to Lena, in the specified time, the whole of the properties which formed the subject of its concession; that it had prevented the company from securing supplies of raw materials, food, clothing, and other goods, and from selling its products freely in the markets of the U. S. S. R.; that it had failed to secure for the concession, on a footing of equality with State enterprises, the necessary facilities for transport; that it had failed to give adequate protection to the properties, and had terrorized its employees; and that, to cut a long story short, it had deliberately put such obstacles in the way of the company as to make the fulfilment of its part of the bargain a virtual impossibility.

For these reasons, Lena informed the Soviet Government, on March 7th of this year, that it could no longer continue to operate the concession. Work was stopped, and both parties proceeded to discuss the composition of the arbitration tribunal for which the concession agreement provided. Following negotiations extending over several weeks, the personnel of the court was satisfactorily arranged, and sittings were about to open in Berlin, when, on April 29th, Lena informed the Government that "resumption of work had become entirely impossible." On May 1st the company followed up this repudiation of responsibility by the withdrawal of power of attorney from its local representative, and an intimation to its foreign employees in Russia that they could return home, thereby irretrievably abandoning the whole enterprise before the court had met. The Soviet Government regarded this as a breach of paragraph 86 of the agreement, in accordance with which the concession could only be wound up by the decision of an arbitration court, and refused to have anything more to do with the process. The court, consequently, met in London with Dr. Otto Stutzer, of the Mining Academy in Freiburg, as the superarbitrator, and Sir Leslie Scott, K. C., as the nominee of Lena Goldfields, the Soviet Government being unrepresented. On Tuesday last the court decided that the Soviet Government had, in fact, rendered the continuation of the concession impossible and ordered it to pay the company the sum of £12,965,000 sterling as compensation, all moneys due to the company to carry interest at the rate of 12 per cent per annum.

In September, 1930, it was reported that the Soviet authorities had recommenced operations at the Lena properties almost at full capacity.

The only privately owned lead-zinc mining enterprise now remaining in Russia is the Tetiuhe Mining Corporation, which operates a mine about 250 kilometers north of Vladivostok. During the fiscal year ended September 30, 1929, the company produced 50,487 [37] tons of ore, averaging 15.06 per cent zinc and 10.49 per cent lead. The mill produced 13,923 tons of zinc concentrates, containing 45.06 per cent zinc, and 6,335 tons of lead concentrates, assaying 74.47 per cent lead and 58.35 ounces silver per ton. Operations during the year resulted in a loss. The second mill unit was brought into operation on October 1, 1929, raising the total crushing capacity to 400 tons daily. Ore reserves at the end of the fiscal year were estimated at 910,754 tons, containing 12.95 per cent zinc, 10.33 per cent lead, and 7.74 ounces silver per ton. The company is building a lead smelter which should be operating by the end of 1930. The zinc concentrates will be treated at the Konstantinovka distillation plant when completed.

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[37] Min. Mag., London, vol. 43, No. 3, September, 1930, p. 192.

SPAIN

The smelter production of Spain in 1929 amounted to 11,800 metric tons of slab zinc, as compared to 13,500 tons in 1928, the decrease being attributed in part to the low lead and zinc prices. The production of zinc ore in 1929 amounted to 145,000 tons containing 51,000 tons of zinc, as compared with 122,000 tons containing 45,000 tons of zinc in 1928. The Province of Santander produced 58 per cent of the 1929 ore output and Murcia 21 per cent. A large quantity of the Spanish ore is exported. In 1929 France took 53,000 tons and Germany 7,000 tons. Data on exports to other countries are not available.

SWEDEN

The smelter output of Sweden during 1929 amounted to 4,718 metric tons, as compared with 5,106 tons in 1928. The 1929 mine production is officially reported as 30,000 tons of zinc, in comparison with 14,000 tons in 1928. Exports of ore increased from 39,982 tons in 1928 to 75,504 tons in 1929. Belgium, Germany, and France were the principal consumers. Imports of slab zinc totaled 8,791 tons in 1929, compared with 7,178 tons in 1928, whereas exports amounted to 4,718 tons in 1929 and 5,551 tons in 1928.

TUNISIA

About 10,000 metric tons of zinc ore was produced in Tunisia[38] in 1928 and again in 1929, and 6,068 tons was exported in 1929 as compared to 10,718 tons in 1928. Exports went largely to Belgium and France.

The General Refractories (Ltd.),[39] of Sheffield, England, was reported to be erecting a zinc smelter in Tunisia. This will be the first plant built in North Africa and will have a monthly capacity of 600 tons.

YUGOSLAVIA

During 1929 Yugoslavia produced 6,291 metric tons of slab zinc, compared with 4,883 tons in 1928. The smelter production came largely from imported ores, the mine production having amounted to only 340 tons in 1929 and 345 tons in 1928.

An increased production of zinc ore is expected as a result of new activities. The Selection Trust Co. (Ltd.)[40] is developing and prospecting several new properties through its subsidiaries—The Trepca Mines (Ltd.), the Novo Brdo Mines (Ltd.), Belasica Mines (Ltd.), Kopaonik Mines (Ltd.), and Zletovo Mines (Ltd.). The Trepca concession[41] covers an area of 400 to 500 square miles in the region of Kosovska Mitrovica. Practically all work is now being concentrated on the Stantrg mine, 5 miles east of Kos. Mitrovica. About 1,750,000 tons of reserves have been developed, the average grade being 11.5 per cent lead, 10.5 per cent zinc, and 3 ounces silver. The new mill has a capacity of 500 tons daily and was placed in operation in August, 1930.

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[38] Metal Bull., London, No. 1474, Mar. 4, 1930, p. 15.

[39] Metal Bull., London, No. 1493, May 16, 1930, p. 17.

[40] Min. Mag., London, vol. 43, No. 3, September, 1930, company meetings and reports section, p. 40.

[41] Brammall, A., The Stantrg Lead-Zinc Mine, Yugoslavia: Min. Mag., London, vol. 42, No. 1, January, 1930, pp. 9-15.

The Novo Brdo Co.[42] has centered its efforts on the exploration of the Kijnitsa Valley properties, in the Janjevo area. Preliminary work indicates two separate lead-zinc bearing zones, and diamond drilling operations are now being conducted to check previous indications.

The Belasica[43] and Kopaonik mines are located in the region north of the Trepca mines, near Mount Kopaonik.

The Savic Concession, north of Kopaonik Mountain, is being explored by the Peñarroya Co., the Plana mine being the center of operations.

The American Smelting & Refining Co.[44] has an option to operate the Srebrenitsa mines in eastern Bosnia, near the Drina River, 120 kilometers from Belgrade and 80 kilometers from Sarajevo.

EUROPEAN ZINC CARTEL

The European Zinc Cartel was organized in May, 1928, to stabilize the price of zinc, which had been declining steadily throughout 1927 and the early part of 1928. The activities of this organization up to September, 1929, were summarized in detail in the 1928 chapter of this series. Up to that time the cartel had attempted several measures for curtailing production but had achieved little success toward stabilization, since world production decreased only slightly while stocks increased rapidly and the London price declined steadily. Finally at a meeting held in Brussels on November 19, 1929, it was decided to dissolve the present cartel agreement on December 31, 1929.

The failure of the cartel has been attributed to many factors, including the following:

1. Incomplete representation of world industry in membership of the cartel.
2. Lack of forceful leadership.
3. Lack of full cooperation of some members, who favored unrestricted production and ultimate elimination of the marginal producer as a means of achieving stabilization.
4. Increased production by new plants in Norway, France, and Silesia.
5. The announced intention of Mexican producers to send refined metal instead of concentrates to Europe.
6. Failure to include electrolytic zinc in the curtailment program.

At the Brussels meeting a committee was appointed to draft a new cartel agreement which was to be submitted to the members at a later date. The following chronology of events from November, 1929, to November, 1930, is based largely on reports appearing in the Metal Bulletin of London.

November 19, 1929. At a meeting held in Brussels it was decided that the present cartel agreement would be allowed to expire at the end of the year. A committee was appointed to draft a fresh agreement which would be submitted to the members of the cartel in December.

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[42] Min. Mag., London, vol. 42, No. 1, January, 1930, p. 8.
[43] Min. Jour., London, vol. 170, No. 4953, July 26, 1930. p. 603.
[44] Prince, J. D., Consular Report, 332, 756 (10849), Belgrade, Mar. 8, 1930.

December. Negotiations proceeding between Germany and Belgian interests for curtailment of exports of zinc from Belgium into Germany. No progress reported on reorganization of cartel.

January, 1930. Negotiations toward formation of new cartel continued. The Belgian producers were reported as being the prime movers with German interests favorably inclined, provided certain conditions were complied with. Discussions involved an organization with central control which will fix prices and allot quotas to individual producers who will retain their own customers. Territorial limitation being considered.

February. Negotiations toward formation of new cartel reported to have been suspended.

March. An unsuccessful meeting was held in Paris during the first part of the month. American interests were not present. Another was held on March 25 at which a curtailment of 18 per cent was suggested. The German delegates were unable to agree to the proposed curtailment but were willing to agree not to increase production for a period of not to exceed two years, since by that time the new Giesche electrolytic zinc plant at Magdeburg would be completed. The Germans also intimated that should the cartel agreement fail they would seek to have a tariff of £3 per ton imposed on zinc imported into Germany when the price was under £22 a ton.

April. Further conferences were held at Brussels on April 2 and 3 at which the German interests offered to curtail production by 5 to 6 per cent. It was reported that overseas interests had indicated a willingness to curtail exports to Europe. In Europe the leading advocate of the cartel, the Vieille Montagne Co., was said to favor control of sales rather than production.

May. A representative of the European producers was reported to have reached New York to conduct negotiations with trans-Atlantic producers. European producers held another meeting at the end of May. Negotiations were held up because the European producers were unable to agree on a program that would be satisfactory overseas and some French interests wished to hold off until the low price had forced additional works to close. The request of the German zinc producers to the Imperial Tariff Committee for an import duty on zinc was vigorously opposed by the consumers. The committee decided to postpone action until the producers and consumers could reconcile their differences.

June. No new developments were reported in June.

July. The American Smelting & Refining Co. was reported to have agreed to participate in the cartel if the contract would not exceed two years and if shipments of zinc to Europe would be curtailed in same proportion as European production. On July 19 zinc producers of Belgium, France, Germany, Silesia, Great Britain, Australia, Canada, and Mexico, representing 87 per cent of the production outside of the United States, met at Ostend and agreed to a preliminary plan which included—

1. Seventy-seven per cent of the zinc production outside of the United States would be allocated to European producers and 23 per cent to Mexican, Canadian, and Australian producers.
2. Individual quotas would be prorated according to the highest successive three months output during the period January 1, 1927, to June 30, 1930.
3. The duration of the cartel is fixed for two years and is renewable annually. It may be dissolved by the entrance of a new outsider coming into operation with an annual capacity of 20,000 tons or more, if United States exports more than 1,000 tons a month, or if new tariffs come into effect without agreement regarding sales quotas in the protected market.
4. The rate of restriction will be varied from time to time as conditions warrant.
5. It is not the present intention to force up prices. A pool fund will be formed for clearing variations in the basic price so that all participants will be interested in all sales made during any period. A joint sales office will not be established, but it is proposed to create a special sales direction. Many points in this phase of the agreement have not been clearly set forth in the literature.
6. Final establishment of the cartel will depend upon final ratification by the producers represented at the conference and by the 13 per cent not present.

August. The final draft of the cartel's statute was forwarded to the various producers for ratification.

October. Ratification of the Ostend agreement was not forthcoming. A meeting was held in Paris on the 21st at which the European producers were reported to have agreed to a 30 per cent curtailment subject to a 15 per cent curtailment by overseas producers. The basis for computing the curtailment was not announced. It was also reported that a French-Spanish producer was dissatisfied with the production quota allotted to it. The meeting adjourned for a month during which time agreement to the above plan would be sought.

TARIFF

The tariff act of 1930, which became effective June 18, 1930, contains important increases in duties on zinc ores containing less than 25 per cent zinc, high-strength lithopone, and zinc sulphide. The rates under the acts of 1922 and 1930 are shown in the following statement.

Import duties on the principal zinc commodities under the tariff acts of 1922 and 1930

Par. 1930 act	Item	Import duty	
		Act of 1922	Act of 1930
393	Zinc in zinc-bearing ores:[1]		
	Containing less than 10 per cent zinc	Free	1½ cents per pound.
	Containing 10 to less than 20 per cent zinc	½ cent per pound	Do.
	Containing 20 to less than 25 per cent zinc	1 cent per pound	Do.
	Containing 25 per cent or over	1½ cents per pound	Do.
394	Zinc in blocks, pigs, or slabs and zinc dust	1¾ cents per pound	1¾ cents per pound.
	Zinc in sheets	2 cents per pound	2 cents per pound.
	Zinc in sheets coated or plated with nickel or other metal (except gold, silver, or platinum) or solutions	2¼ cents per pound	2¼ cents per pound.
	Old and worn out zinc, fit only to be remanufactured, zinc dross, and zinc skimmings	1½ cents per pound	1½ cents per pound.
397	Articles or wares not specially provided for, if composed wholly or in chief value of zinc, but not plated with platinum, gold, or silver, or colored with gold lacquer, whether partly or wholly manufactured	40 per cent ad valorem	45 per cent ad valorem.
77	Zinc pigments:		
	Zinc oxide and leaded zinc oxide containing not more than 25 per cent of lead, in any form of dry powder	1¾ cents per pound	1¾ cents per pound.
	Ground in or mixed with oil or water	2¼ cents per pound	2¼ cents per pound.
	Lithopone, and other combinations or mixtures of zinc sulphide and barium sulphate containing by weight less than 30 per cent of zinc sulphide	1¾ cents per pound	1¾ cents per pound.
	Containing by weight 30 per cent or more of zinc sulphide	do	1¾ cents per pound and 15 per cent ad valorem.
93	Zinc chemicals:		
	Zinc chloride	1 3/10 cents per pound	1 3/10 cents per pound.
	Zinc sulphate	¾ of 1 cent per pound	¾ of 1 cent per pound.
	Zinc sulphide	1½ cents per pound	3 cents per pound.

[1] The 1930 act specifically excepts from duty: (1) The zinc content of pyrite containing less than 3 per cent zinc. (2) The zinc content of lead and copper ores not actually recovered.

IMPORTS AND EXPORTS

IMPORTS

The chief zinc import of the United States is zinc ore, most of which is imported under bond so that it can be smelted and the metallic zinc therefrom reexported without payment of import duties. In 1929, 14,411 tons of zinc in ore was imported. This and the 2,480 tons withdrawn from bonded warehouse during the year indicate a total of 16,891 tons of zinc in foreign ore available for smelting in 1929. The amount of zinc produced from foreign ore in 1929 was reported by smelters as 13,311 tons.

The following tables give the Bureau of Foreign and Domestic Commerce record of zinc ore imported into the United States from 1920 to 1929 and a record of bonded warehouse inventories.

Zinc ore imported into the United States, 1920–1929, in short tons

[General imports]

Year	Canada		Mexico		Other countries		Total	
	Ore	Zinc content	Ore	Zinc content	Ore	Zinc content	Ore	Zinc content
1920	4,731	1,794	47,453	14,975	13,589	5,718	65,773	22,487
1921	1,471	554	6,050	2,147	18	4	7,539	2,705
1922	(1)	235	(1)	1,665	(1)	29	(1)	1,929
1923	(1)	4	(1)	3,201	(1)	18	(1)	3,223
1924	----------	----------	(1)	4,649	----------	----------	(1)	4,649
1925	(1)	3,894	(1)	9,607	(1)	35	(1)	13,536
1926	(1)	2,281	(1)	12,265	(1)	21	(1)	14,567
1927	(1)	217	(1)	9,285	(1)	11	(1)	9,513
1928[2]	(1)	18	(1)	1,646	(1)	3	(1)	1,667
1929	(1)	848	(1)	13,563	----------	----------	(1)	14,411

[1] Gross weight not recorded.

[2] Figures probably incomplete.

Zinc remaining in warehouse in the United States, December 31, 1920–1929

Year	Ore and calamine		Blocks, pigs, and old		Zinc dust	
	Zinc content (pounds)	Value	Pounds	Value	Pounds	Value
1920	51,299,109	$996,386	----------	----------	----------	----------
1921	28,583,018	647,654	262,221	$10,911	----------	----------
1922	----------	----------	160,976	6,396	----------	----------
1923	1,736,874	84,977	160,976	6,396	[1] 2,048	[1] $256
1924	12,103,110	494,605	----------	----------	[1] 998	[1] 38
1925	40,938,685	1,936,332	----------	----------	----------	----------
1926	27,580,974	1,331,318	----------	----------	----------	----------
1927	12,287,028	592,206	----------	----------	----------	----------
1928	8,719,290	797,923	----------	----------	----------	----------
1929	3,758,809	113,479	----------	----------	----------	----------

[1] Includes manufactures of zinc.

The United States imports very little slab zinc, rolled zinc, and manufactured zinc products. In 1929 the total value of these imports was $169,512, of which $128,395 represented the value of manufactured products. A considerable amount of old brass is imported, chiefly from Canada. In 1929 that country supplied 89 per cent of the total imports of brass. The increase in imports in 1929 probably resulted from the high price of copper.

Zinc imported for consumption in the United States, 1920–1929

Year	Blocks or pigs		Sheets		Old		Zinc dust		Value of manufactures	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1920	(1)	$17	4	$614	14	$1, 065	17	$6, 207	$1, 746	$9, 649
1921	6, 598	559, 870	6, 688	496, 445	6	341	42	1, 121	8, 290	1, 066, 067
1922	40	3, 327	416	59, 037	46	2, 403	79	5, 614	9, 517	79, 898
1923	1	375	(1)	41	20	1, 624	4	891	16, 331	19, 262
1924	11	1, 973	(1)	88	14	1, 493	59	9, 241	20, 089	32, 884
1925	(1)	303	(1)	55	24	2, 495	116	20, 936	18, 979	42, 768
1926	(1)	195	(1)	46	21	1, 315	2	451	44, 574	46, 581
1927	39	5, 089	1	271	19	1, 443	(1)	114	91, 519	98, 436
1928	(1)	66	3	2, 556	3	260	146	14, 147	115, 784	132, 813
1929	226	21, 502	(1)	52	(1)	20	159	19, 543	128, 395	169, 512

[1] Less than 1 ton.

Old brass, fit only for remanufacture, imported into the United States, 1920–1929

[General imports; average composition about one-third zinc and two-thirds copper]

Year	Short tons	Value	Year	Short tons	Value
1920	22, 355	$5, 174, 885	1925	5, 374	$772, 906
1921	20, 449	2, 373, 082	1926	4, 311	631, 973
1922	71, 962	10, 985, 308	1927	3, 993	556, 064
1923	20, 395	3, 992, 917	1928	6, 075	1, 015, 172
1924	4, 636	698, 022	1929	7, 031	1, 371, 655

EXPORTS

The total value of the 1929 exports of zinc ore and domestic and foreign manufactures of zinc (not including galvanized products, alloys, and pigments) amounted to approximately $3,400,000, representing decreases of 25 per cent from 1928 and of 81 per cent from the recent high in 1925.

The following table shows the principal zinc exports of the United States during the past 10 years.

Domestic zinc ore and domestic manufactures of zinc exported from the United States, 1920–1929

Year	Zinc ore and concentrates		Pigs or slabs		Plates and sheets		Zinc dross		Zinc dust	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1920	--------	------------	74, 046	$12, 495, 144	11, 852	$2, 832, 993	2, 445	$316, 637	(1)	(1)
1921	--------	------------	1, 753	204, 984	1, 816	425, 618	510	45, 340	(1)	(1)
1922	1, 695	$33, 592	26, 815	2, 994, 625	3, 217	574, 491	8, 412	662, 080	1, 998	$287, 890
1923	[2]2, 804	(2)	42, 131	5, 961, 525	3, 732	764, 369	[3]14, 745	[3]1, 221, 986	3, 679	507, 289
1924	[2]368	(2)	[4]72, 583	[4]9, 538, 459	3, 658	784, 728	[3]10, 845	[3]974, 179	2, 270	353, 867
1925	68, 951	3, 277, 118	[4]76, 351	[4]11, 654, 441	4, 196	926, 841	15, 968	1, 567, 697	2, 242	408, 017
1926	95, 252	4, 056, 067	[4]42, 920	[4]6, 360, 671	4, 641	1, 086, 967	10, 461	1, 100, 988	1, 091	224, 841
1927	46, 716	1, 690, 523	[4]45, 695	[4]6, 035, 382	3, 922	869, 425	4, 451	296, 489	1, 357	259, 209
1928	4, 518	205, 978	[4]25, 289	[4]3, 013, 679	4, 325	906, 515	3, 148	240, 613	1, 008	199, 081
1929	71	2, 434	[4]14, 411	[4]1, 879, 039	5, 265	1, 075, 000	3, 490	217, 019	1, 256	250, 447

[1] Figures not available prior to 1922.

[2] Not separately enumerated by Bureau of Foreign and Domestic Commerce in 1922 and 1923 but included with "Zinc dross"; Canadian smelters reported imports of 2,804 tons of zinc ore and concentrates from the United States in 1923; exporters from the Joplin district reported 368 tons of concentrates shipped to Belgian smelters in 1924.

[3] Exports of zinc ore and dross are lumped together; these figures include the quantity and value of zinc ore exported as shown in the first column.

[4] Exports of slab zinc made from foreign ore are not given separately but have been included with domestic exports after 1923.

For many years slab zinc has been the largest single item of zinc exports, and in 1929 it accounted for 55 per cent of the total value. Over 14,400 tons, valued at about $1,880,000, were exported in 1929, a decrease of 43 per cent in quantity and 38 per cent in value from 1928. Exports of slab zinc have declined 81 per cent since 1925, due to increased production in Europe and to the inability of American producers to compete in European markets under the low price of zinc prevailing during the last few years. The drop in exports in 1929 was largely due to decreased shipments to Japan, which took 10,067 tons in 1928 and only 587 tons in 1929. The loss of this trade was due in part to an increase in production and a decrease in consumption in Japan, but it is significant that Japanese imports from Canada and Australia decreased only slightly in 1929. Europe took 10,502 tons in 1929 as compared to 13,526 tons in 1928. United Kingdom was the largest importer, France second, and Germany third. Shipments to the United Kingdom in 1929 increased to four times those in 1928, but shipments to France and Germany decreased about 50 per cent. Exports to British India ranked fourth in 1929, indicating a renewal of trade which was practically suspended in 1927 and 1928.

The following table shows the destination of the exports of zinc ore, slab zinc, and sheet zinc in 1928 and 1929.

Domestic zinc ore and domestic and foreign manufactures of zinc exported from the United States, 1928 and 1929, by destinations

Destination	Ore and concentrates		Slabs, blocks, or pigs		Sheets, strips, etc.	
	Short tons	Value	Short tons	Value	Short tons	Value
1928						
North America:						
Canada	----------	----------	770	$99,364	1,877	$334,962
Cuba	----------	----------	20	4,260	63	18,577
Mexico	----------	----------	86	19,339	53	18,036
Panama	----------	----------	13	1,725	15	2,410
Other	----------	----------	9	1,816	36	8,415
	----------	----------	898	126,504	2,044	382,400
South America:						
Argentina	----------	----------	30	3,959	212	47,858
Brazil	----------	----------	71	11,839	68	16,213
Chile	----------	----------	590	66,509	22	7,550
Colombia	----------	----------	1	296	56	12,829
Peru	----------	----------	5	811	14	4,743
Other	----------	----------	16	3,103	19	5,915
	----------	----------	713	86,517	391	95,108
Europe:						
Belgium	532	$23,350	296	35,310	----------	----------
France	1,892	82,000	4,187	487,773	7	1,232
Germany	1,664	75,600	4,330	523,416	6	1,228
Italy	----------	----------	1,663	201,390	1	186
Netherlands	----------	----------	742	95,836	32	5,207
Sweden	----------	----------	913	112,927	47	15,262
United Kingdom	13	480	1,152	132,365	1,385	313,762
Other	287	20,648	243	29,731	41	10,523
	4,388	202,078	13,526	1,618,748	1,519	347,400
Asia:						
China	----------	----------	46	7,173	37	12,482
India (British)	----------	----------	----------	----------	5	1,669
Japan	130	3,900	10,067	1,167,779	219	35,464
Philippine Islands	----------	----------	4	787	49	11,950
Other	----------	----------	(1)	92	21	7,464
	130	3,900	10,117	1,175,831	331	69,029

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[1] Less than 1 ton.

Domestic zinc ore and domestic and foreign manufactures of zinc exported from the United States, 1928 and 1929, by destinations—Continued

Destination	Ore and concentrates		Slabs, blocks, or pigs		Sheets, strips, etc.	
	Short tons	Value	Short tons	Value	Short tons	Value
1928—Continued						
Africa			33	$5,620	2	$445
Oceania, including Australia			2	459	38	12,133
	4,518	$205,978	25,289	3,013,679	4,325	906,515
1929						
North America:						
Canada	61	1,950	974	128,892	2,124	384,602
Cuba					60	17,618
Mexico			22	3,965	149	31,919
Panama			8	1,125	25	4,929
Other			2	524	33	7,910
	61	1,950	1,006	134,506	2,391	446,978
South America:						
Argentina			3	382	193	46,740
Brazil			9	2,370	36	11,026
Chile			565	80,285	26	8,458
Colombia			44	6,033	40	9,553
Peru			4	561	17	6,048
Other	2	116	1	165	20	6,369
	2	116	626	89,796	332	88,194
Europe:						
Belgium			420	100,480		
France			2,299	289,021	13	2,338
Germany	8	368	1,961	223,138	35	4,559
Italy			56	7,397	1	228
Netherlands			554	64,491	58	8,435
Soviet Russia			8	1,254	2	490
Sweden			487	64,169	39	12,724
United Kingdom			4,717	613,235	1,592	367,664
Other			(1)	19	32	8,505
	8	368	10,502	1,363,204	1,772	404,943
Asia:						
China			(1)	57	38	12,226
India (British)			1,681	220,114	340	47,320
Japan			587	69,528	270	40,024
Philippine Islands			8	1,555	52	13,241
Other					26	7,907
			2,276	291,254	726	120,718
Africa					1	365
Oceania, including Australia			1	279	43	13,802
	71	2,434	14,411	1,879,039	5,265	1,075,000

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(1) Less than 1 ton.

Plates and sheets were the second largest item of the United States zinc-export trade in 1929 and increased 22 per cent over 1928. Canada and the United Kingdom were the principal recipients and each received increased amounts in 1929. Canada took 40 per cent of the total United States export and United Kingdom 30 per cent.

Exports of zinc ore and concentrates, which decreased tremendously in 1928, practically disappeared in 1929. The following table shows the zinc-ore exports during the past three years, by customs districts.

Domestic zinc ores and concentrates exported from the United States, 1927–1929, by customs districts, in short tons

District	1927	1928	1929	District	1927	1928	1929
New York	----------	300	10	Oregon	15,802	----------	----------
Buffalo	81	----------	61	Philadelphia	7	----------	----------
Galveston	1,902	----------	----------	San Francisco	10,538	2,196	----------
Los Angeles	1,782	----------	----------	Washington	1,523	130	----------
Michigan	37	----------	----------				
New Orleans	15,044	1,892	----------		46,716	4,518	71

Exports of zinc dross in 1929 increased 11 per cent in quantity and decreased 10 per cent in value as compared with 1928.

Exports of zinc dust amounted to 1,256 tons in 1929, as compared with 1,008 tons in 1928. Mexico took 62 per cent of the total in 1927 and in 1928 and 55 per cent in 1929.

There was a slight decrease in the total value of brass and brass manufactures exported in 1929.

Domestic brass[1] *and brass manufactures exported from the United States, 1920–1929*

[Zinc content approximately 30 per cent by weight]

Year	Bars, plates, and sheets		Scrap and old[2]		Articles made from brass (value)	Total value
	Short tons	Value	Short tons	Value		
1920	2,905	$1,671,608	1,030	$254,189	$13,202,854	$15,128,651
1921	1,437	741,110	2,969	405,871	7,123,366	8,270,347
1922	1,830	635,449	3,147	514,322	7,675,979	8,825,750
1923	1,733	703,503	6,587	1,198,560	6,917,901	8,819,964
1924	2,265	740,993	29,294	5,352,197	6,299,046	12,392,236
1925	3,988	1,359,594	48,189	9,889,153	7,315,707	18,564,454
1926	2,377	884,907	25,132	4,944,277	7,844,746	13,673,930
1927	1,756	648,853	45,997	8,824,029	8,043,131	17,516,013
1928	2,202	905,430	42,413	7,947,218	8,765,231	17,617,879
1929	2,935	1,330,119	[3] 27,746	[3] 6,167,038	10,005,920	17,503,077

[1] Beginning 1922, classification reads "Brass and bronze."
[2] 1925–1928, inclusive, classification reads "Ingots, scrap, and old."
[3] Includes 879 tons of ingots, valued at $267,639.

Foreign zinc exported from the United States, 1920–1929

Year	Exported from warehouse			Exported in manufactures with benefit of drawback, slabs and sheets excluded (short tons)
	Blocks, pigs, and old		All other manufactures (value)	
	Short tons	Value		
1920	28,132	$4,331,636	----------	237
1921	1,256	100,677	$10,785	130
1922	3,471	429,122	30,227	1,298
1923	7,080	941,257	(1)	----------
1924–1928	(2)	(2)	(2)	----------
1929	(2)	(2)	(2)	27,313

[1] Not given separately.
[2] Exports of slab zinc made from foreign ore are not given separately but have been included with domestic exports after 1923.

CONSUMPTION

APPARENT DELIVERIES OF PRIMARY SLAB ZINC TO DOMESTIC CONSUMERS

Primary slab zinc available for consumption in the United States, 1920–1929, in short tons

	1920	1921	1922	1923	1924
Supply:					
Stock Jan. 1—					
In bonded warehouse	----------	----------	131	80	80
At smelters	36,793	71,037	70,321	16,810	27,808
Production	463,377	200,500	354,277	510,434	517,339
Imports, foreign	15	6,739	52	21	25
Imports, domestic, returned	8,162	731	----------	----------	----------
Total available	508,347	279,007	424,781	527,345	545,252
Withdrawn:					
Exports, foreign, from warehouse	28,132	1,256	3,471	7,080	(1)
Exports, foreign, under drawback	237	130	1,298	----------	----------
Exports, domestic	85,898	3,569	30,032	45,863	[1] 76,241
Stock Dec. 31—					
In bonded warehouse	----------	131	80	80	(2)
At smelters	71,037	70,321	16,810	27,808	20,754
Total withdrawn	185,304	75,407	51,691	80,831	96,995
Available for consumption	323,043	203,600	373,090	446,514	448,257

	1925	1926	1927	1928	1929
Supply:					
Stock Jan. 1—					
In bonded warehouse	(2)	----------	----------	----------	----------
At smelters	20,754	13,080	26,937	53,522	48,432
Production	572,946	618,422	592,516	602,581	625,447
Imports, foreign	24	22	59	3	226
Total available	593,724	631,524	619,512	656,106	674,105
Withdrawn:					
Exports, foreign, from warehouse	(1)	(1)	(1)	(1)	(1)
Exports, domestic	[1] 80,547	[1] 47,561	[1] 49,617	[1] 29,614	[1] 19,676
Stock Dec. 31—					
At smelters	13,080	26,937	53,522	48,432	85,904
Total withdrawn	93,627	74,498	103,139	78,046	105,580
Available for consumption	500,097	557,026	516,373	578,060	568,525

[1] Foreign exports included under domestic exports.

[2] 998 pounds.

The foregoing table includes only primary slab zinc or zinc produced from ores. In addition, a substantial tonnage of redistilled secondary zinc is produced at primary smelters each year, most of which is inseparable from primary metal. For this reason smelter stocks at the end of the year and exports of domestic zinc probably contain some secondary metal. Although the amount is relatively small the slight inconsistency in the table should be noted. More precise segregation of figures for primary and secondary metal is practically impossible. Since the table does not take into consideration the fluctuation in consumers' stocks the trend of consumption of primary zinc is indicated only in a general way.

The supply of new zinc available for consumption in 1929 was 2 per cent less than in the record year of 1928, but exceeded that of 1927 by 10 per cent, and that of 1926 (the previous peak) by 2 per cent.

CONSUMPTION BY USES

Zinc ore may be used for the manufacture of slab zinc, zinc dust, pigments, and salts. This chapter is concerned chiefly with slab zinc, and the discussion that follows is confined to the uses of that product.

Besides the primary slab zinc a large quantity of secondary zinc was recovered in the form of slab zinc, brass and other alloys, pigments, salts, and zinc dust. These items have been discussed briefly in a previous section (p. 685) of this chapter and in more detail in the Mineral Resources chapter on Secondary Metals. The secondary zinc recovered in 1929 in the form of slab zinc, brass, and other alloys amounted to 142,670 tons. Owing to the lack of data regarding stocks it is impossible to state how much of this metal was actually consumed in 1929. It should be noted, however, that the quantity of secondary zinc recovered as slab zinc and in alloys during the last five years has averaged 26 per cent of the supply of new zinc available for consumption.

The three chief uses of slab zinc are in the manufacture of zinc-coated (galvanized) products, in brass making, and in the manufacture of sheet zinc. Other minor uses are in the manufacture of French oxide, atomized zinc dust, die castings, and slush castings, and for desilverization of lead. The following table, which shows the estimated industrial use of zinc in the United States from 1921 to 1929, has been taken from the Year Book of the American Bureau of Metal Statistics, 1929.

Estimated industrial use of zinc in the United States, 1921–1929, in short tons [1]

Purpose	1921	1922	1923	1924	1925	1926	1927	1928	1929
Galvanizing:									
Sheets	72, 500	110, 800	121, 300	122, 900	138, 000	142, 500	138, 500	144, 100	142, 800
Tubes	28, 200	44, 100	49, 000	50, 300	61, 100	62, 100	54, 000	54, 200	52, 200
Wire	19, 500	25, 000	32, 700	29, 000	35, 700	34, 200	38, 500	41, 300	39, 000
Wire cloth	3, 800	6, 100	6, 100	7, 100	6, 800	6, 800	6, 500	8, 400	10, 800
Shapes [2]	14, 100	19, 400	26, 100	30, 700	41, 400	44, 400	42, 500	43, 000	45, 200
	138, 100	205, 400	235, 200	240, 000	283, 000	290, 000	280, 000	291, 000	290, 000
Brass making and casting [3]	75, 000	145, 000	175, 000	155, 000	165, 000	180, 000	160, 000	174, 000	180, 000
Rolled zinc	30, 400	53, 500	55, 800	61, 000	71, 100	86, 300	74, 100	73, 500	68, 300
Die castings	(4)	(4)	(4)	(4)	(4)	13, 500	18, 000	30, 000	36, 000
Other purposes [5]	19, 000	36, 000	49, 000	56, 000	60, 000	52, 500	51, 000	58, 000	54, 000
	262, 500	439, 900	515, 000	512, 000	579, 100	622, 300	583, 100	626, 500	628, 300

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[1] Year Book, American Bureau of Metal Statistics, 1929, p. 79.

[2] Includes pole-line hardware, hollow ware, chains, and all articles not elsewhere mentioned. The estimates for the use of slab zinc under this head, and also for wire cloth, are probably incomplete. The enumeration for 1924 includes figures from consumers not previously accounted for.

[3] Includes all casting other than die casting, slush casting, and battery zinc.

[4] Included in "Other purposes."

[5] Includes slab zinc used for manufacture of French oxide, lithopone, atomized zinc dust, die castings (through 1925), slush castings, and for the desilverization of lead.

The foregoing table is based upon reports from consumers and includes both primary and secondary slab zinc. The Bureau of Mines estimate of primary zinc available for consumption is based upon reports from producers; if the estimated production of secondary metal is added to this it will be found that the total exceeds the estimated industrial use of zinc, as reported by the American Bureau of Metal Statistics, by less than 6,000 tons or about 1 per cent of the total zinc consumed. This comparison for the last five years is shown in the following table.

Comparison of figures for consumption of zinc, 1925–1929, as computed by Bureau of Mines and by American Bureau of Metal Statistics, in short tons

	1925	1926	1927	1928	1929
Apparent consumption of primary zinc as per Bureau of Mines	500,097	557,026	516,373	578,060	568,525
Industrial use of zinc as per American Bureau of Metal Statistics	579,100	622,300	583,100	626,500	628,300
Excess as per American Bureau of Metal Statistics	79,003	65,274	66,727	48,440	59,775
Recovery of unalloyed secondary zinc as per Bureau of Mines	61,430	64,570	64,800	70,700	65,400

The estimated industrial use of zinc increased less than one-third of 1 per cent in 1929 but was the largest on record. Consumption of iron increased 8 per cent, copper 16 per cent, and lead 2 per cent. Some of the basic factors contributing to the increased use of zinc were increases of 23 per cent in the number of automobiles and trucks manufactured and 16 per cent in the industrial building contracts awarded.

The galvanizing industry is the largest user of slab zinc and has accounted for 47 per cent of the total zinc used in the United States during the past five years. In 1929 the consumption of zinc in this industry was slightly less than in 1928.

Brass making provides the second largest use of slab zinc and has accounted for 28 per cent of the total consumption during the past five years. It is of interest that the use of zinc in brass has failed to keep pace with the general increase in consumption during the past few years. In 1922 about 33 per cent of the total slab zinc consumed was in brass, whereas in 1929 the percentage was only 29 per cent. In 1929, however, consumption of zinc in brass was 3 per cent more than in 1928. There was a marked increase in the value of the export of articles made from brass, a decided decrease in the quantity and value of old and scrap brass exports, and a gain in exports of bars, plates, and sheets. The total value of all exported brass decreased slightly.

The use of zinc in the manufacture of rolled-zinc products again decreased in 1929. This decrease amounted to 7 per cent as compared to 1928 and 21 per cent as compared to 1926, the record year. This phase of zinc consumption has been adversely affected by the decreased use of dry cells in radio-receiving sets.

Another important use of zinc, and one that presents a promising future, is as the essential constituent of die-casting alloys. During the last three years the use of zinc for this purpose has doubled. In 1929 it was estimated that 36,000 tons was so used, as compared to 18,000 tons in 1927. Articles now being die cast from zinc-base alloys include loud-speaker cases, radio-instrument dials, many automobile parts (including hub caps and intricate carburetor parts), soda-water dispensers, pencil-sharpener bodies, and smoking stands. During 1929 a new die-casting alloy with high torsional and tensile strength was developed and proved to be successful for gears on the electric motor drives of gasoline pumps, shock-absorber parts, and other mechanical applications.

Other miscellaneous uses accounted for 54,000 tons of zinc or nearly 9 per cent of the the total in 1929. Approximately 73 per cent of this item is chargeable to the 39,600 tons of slab zinc used in the manufacture of French-process zinc oxide, as reported by the Bureau of Mines. About 5,000 tons of zinc is used annually in the Parkes process for desilverizing lead. Some zinc was used in the manufacture of atomized zinc dust in 1929.

The question as to whether or not the American Zinc Institute should inaugurate a research program for the purpose of expanding the market for zinc was the principal subject discussed at the institute's twelfth annual meeting held in April, 1930. It was stated that the demand for galvanized products, the principal consumer of zinc, was not keeping pace with the growth of the nation, due largely to competition from products, such as composition roofing. Moreover, the maintenance of this market had been left entirely in the hands of the galvanizers, whose principal interest was in selling iron and steel and who might discontinue the use of zinc should a better or cheaper coating be developed. In view of this unsatisfactory situation a research department was created in the institute to cooperate with the galvanizers in solving marketing problems.

The trend in the brass industry toward the use of some alloys containing more copper and less zinc has probably been responsible for the failure of brass to keep pace with the general expansion in the use of zinc. This trend is illustrated in the consumption of brass pipe. According to W. A. Willis,[45] the quantity of brass pipe consumed between 1927 and 1929 increased 24 per cent and the quantity of zinc used in this product decreased 7 per cent. However, the same authority believes that the general increase in the use of brass will offset the decrease in special fields, such as that mentioned above.

The New Jersey Zinc Co. has developed a new zinc alloy for roofing called zilloy, which contains 1 per cent copper and 0.01 per cent magnesium. Its greatly increased strength permits its use over supports spaced the same distance (54 inches) as is commonly used under galvanized sheets. The use of sprayed-zinc coatings, for which high-grade zinc wire is generally used, is said to be increasing. It is claimed that no zinc-iron alloy, which is cathodic to steel, is formed. This method of coating is especially effective on assembled parts. Noncorroding copper-zinc-lead-tin alloys are being tried out experimentally on catenary equipment on railroads where both steam and electric locomotives operate. An alloy with high resistance to corrosion from locomotive smoke and high electrical conductivity is desired. A new alloy containing 81 to 82 per cent copper, 14 per cent zinc, 4 to 5 per cent silicon, and 0.5 per cent tin has been developed in Germany. It is said to be an excellent bell metal equal to the standard copper-tin alloy. Other alloys of similar composition can be worked hot and cold and have outstanding properties as bearing metal.

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[45] Willis, William A., Zinc in Brass: Zn, vol. 13, 1930, p. 83.

PRICES AND VALUE

The slow upward trend in the price of zinc which persisted throughout most of 1928 continued until October, 1929, when the quotations dropped in sympathy with the collapse of the stock market. During January and February the St. Louis quotation for prime western zinc averaged 6.34 cents per pound, but by April 1 it had increased to 6.80 cents due largely to increased consumption. This rise, no doubt, was assisted also by the sharp increase in the price of lead resulting from the revolution in Mexico, which threatened the supply of lead from that country. In April and May the price was depressed somewhat, but recovered again in June and from July to October was well maintained at over 6.7 cents notwithstanding a substantial decrease in consumption and a rapid increase in stocks. The average price for October was 6.72 cents, but following the stock market crash, it decreased to 6.22 cents in November and 5.65 cents in December. The quotation on December 31, 1929, was 5.45 cents as compared with 6.35 cents a year before. The average for the year was 6.49 cents, as compared with 6.03 cents in 1928, an increase of 8 per cent.

The London price increased from 5.67 cents per pound in January to 5.86 cents in March, but thereafter declined steadily, a marked contrast to the St. Louis price, which increased fairly steadily until the latter part of October. The London average for December was 4.37 cents, and during that month the quotation reached the lowest point in 21 years. The average for the year was 5.4 cents, as compared with 5.5 cents in 1928. This was a decrease of 2 per cent, whereas the St. Louis average increased 8 per cent. In January the London price averaged 0.67 cent under that for St. Louis, but by October the difference had increased to 1.74 cents.

The following table shows monthly fluctuations in price of prime western zinc at St. Louis during 1924 to 1929 and at London during 1929.

Average monthly quoted price of zinc at St. Louis, 1924–1929, and at London, 1929, in cents per pound [1]

Month	St. Louis (for immediate delivery)						London,[2] 1929
	1924	1925	1926	1927	1928	1929	
January	6.42	7.76	8.45	6.68	5.65	6.34	5.67
February	6.76	7.51	7.84	6.69	5.55	6.34	5.68
March	6.49	7.34	7.34	6.71	5.63	6.45	5.86
April	6.13	7.00	7.01	6.35	5.76	6.63	5.79
May	5.78	6.96	6.82	6.08	6.04	6.56	5.79
June	5.79	7.00	7.12	6.23	6.16	6.64	5.68
July	5.90	7.22	7.42	6.24	6.20	6.74	5.49
August	6.18	7.59	7.39	6.36	6.25	6.78	5.39
September	6.19	7.77	7.42	6.22	6.25	6.78	5.24
October	6.33	8.33	7.31	6.00	6.25	6.72	4.98
November	6.80	8.72	7.22	5.75	6.27	6.22	4.54
December	7.38	8.71	7.04	5.73	6.35	5.65	4.37
High	7.38	8.72	8.45	6.71	6.35	6.78	5.86
Low	5.78	6.96	6.82	5.73	5.55	5.65	4.37
Average	6.35	7.66	7.37	6.25	6.03	6.49	5.40

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[1] Metal Statistics, 1930, pp. 441 and 447.

[2] Conversion of English quotations into American money based on average monthly rate of exchange, as recorded by the Federal Reserve Board of the Treasury.

New York quoted prices are slightly above St. Louis prices, owing to the freight rate of 0.35 cent per pound between the two cities.

According to reports submitted to the Bureau of Mines the stocks of slab zinc at smelters increased from 48,432 tons on January 1 to 85,904 tons on December 31, 1929.

A large part (43 per cent in 1929) of the zinc ore supply of the United States is produced in the tri-State area commonly known as the Joplin region. Owing to the large quantity and the uniformity of grade and purity of the zinc concentrates produced in the district it has become the custom for the mines to sell their product to the smelters in an open market rather than under the smelter contract system usually prevailing in other mining districts. The average weekly quoted prices for 60 per cent zinc concentrates in this market during 1929 are compared with the St. Louis quotations for prime western and brass special grades of slab zinc in the following table:

Average weekly quoted prices of 60 per cent zinc concentrates at Joplin, Mo., and of zinc of "prime western" and "brass special" grades at St. Louis, in 1929

Week ended—	60 per cent zinc concentrates in the Joplin region (dollars per ton) [1]	Prime western zinc in St. Louis (cents per pound) [2]	Brass special zinc in St. Louis (cents per pound) [2]	Week ended—	60 per cent zinc concentrates in the Joplin region (dollars per ton) [1]	Prime western zinc in St. Louis (cents per pound) [2]	Brass special zinc in St. Louis (cents per pound) [2]
Jan. 5	40.00	6.35	6.45	July 6	44.00	6.70	6.80
Jan. 12	40.00	6.33½	6.45	July 13	44.00	6.68½	6.78½
Jan. 19	40.00	6.32½	6.45	July 20	44.00	6.74	6.82
Jan. 26	40.00	6.34½	6.45	July 27	44.00	6.80	6.85
Feb. 2	40.00	6.35	6.45	Aug. 3	44.00	6.78½	6.85
Feb. 9	40.00	6.34½	6.45	Aug. 10	44.00	6.77	6.82½
Feb. 16	41.00	6.33¾	6.45	Aug. 17	44.00	6.77½	6.82½
Feb. 23	41.00	6.34$\frac{1}{16}$	6.45	Aug. 24	44.00	6.77½	6.82½
Mar. 2	41.00	6.33¾	6.45	Aug. 31	44.00	6.80	6.87½
Mar. 9	41.00	6.33¾	6.45	Sept. 7	44.00	6.80	6.87½
Mar. 16	41.00	6.32½	6.42½	Sept. 14	44.00	6.77½	6.87½
Mar. 23	42.50	6.48	6.58	Sept. 21	44.00	6.77	6.87
Mar. 30	44.00	6.73⅛	6.83⅛	Sept. 28	44.00	6.77½	6.87
Apr. 6	44.00	6.77	6.90	Oct. 5	44.00	6.78½	6.86
Apr. 13	44.00	6.66	6.82	Oct. 12	44.00	6.77½	6.85
Apr. 20	44.00	6.59¼	6.78	Oct. 19	44.00	6.77½	6.85
Apr. 27	44.00	6.53½	6.75	Oct. 26	44.00	6.67½	6.75
May 4	44.00	6.57¾	6.74	Nov. 2	42.00	6.55½	6.63
May 11	44.00	6.53½	6.71	Nov. 9	40.00	6.30	6.36¼
May 18	44.00	6.55½	6.69	Nov. 16	40.00	6.23	6.30
May 25	44.00	6.56½	6.69	Nov. 23	40.00	6.21	6.28½
June 1	44.00	6.56⅞	6.70	Nov. 30	40.00	6.08$\frac{7}{16}$	6.18¾
June 8	44.00	6.55½	6.67½	Dec. 7	38.00	5.94	6.04
June 15	44.00	6.61¾	6.71¾	Dec. 14	36.00	5.78½	5.90½
June 22	44.00	6.67¾	6.78	Dec. 21	35.00	5.47½	5.57½
June 29	44.00	6.70	6.80	Dec. 28	35.00	5.46¼	5.56¼

[1] Joplin Globe, Joplin, Mo.

[2] American Metal Market, daily.

The table shows that the price of concentrates followed the price of slab zinc very closely but did not reflect the small fluctuations in metal price that occurred from April to October. The average price realized on all shipments during 1929, as reported by the American Metal Market, was $42.39 per ton, which was equivalent to 3.5 cents per pound of zinc content. Since the average price of slab zinc was 6.5 cents the difference of 3 cents per pound covers the cost of smelting and marketing, smelting profits, and metallurgical losses. In 1928 the mines realized 3.2 cents per pound of zinc contained in the concentrates as against an average price of 6.0 cents per pound.

The following table shows the actual prices received by producers for various grades of zinc and the total value reported received:

Average price of zinc, 1920–1929, by grades, in cents per pound

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929
Grade A (high grade)	8.4	5.6	6.0	7.1	6.8	7.85	7.65	6.67	6.18	6.80
Grade B (intermediate)	8.3	5.5	6.0	7.1	6.8					
Grades C and D (select and brass special)	8.2	4.9	5.6	6.7	6.4	7.41	7.35	6.24	5.99	6.44
Grade E (prime western)	8.0	4.9	5.6	6.7	6.4	7.59	7.46	6.31	6.08	6.42
All grades	8.1	5.0	5.7	6.8	6.5	7.6	7.5	6.4	6.1	6.6
Prime western; average spot quotation at St. Louis	7.8	4.7	5.7	6.7	6.4	7.7	7.4	6.3	6.0	6.5

The American Metal Market reported the following average quoted prices (cents per pound) for 1928 and 1929:

	1928	1929
High-grade zinc (delivered at eastern points)	7.74	7.88
Brass special (f. o. b. East St. Louis)	6.11	6.60
Prime western (f. o. b. St. Louis)	6.03	6.49
Prime western (f. o. b. New York)	6.38	6.84

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEW MEXICO [1] [2]

(MINE REPORT)

By Chas. W. Henderson

SUMMARY

The total calculated gross value of the recoverable gold, silver, copper, lead, and zinc from lode and placer mines in New Mexico in 1929 amounted to $24,473,675, compared with $18,815,863 in 1928—an increase of 30 per cent. There were 121 producing mines in 1929, comprising 113 lode mines and 8 placers, an increase of 20 lode mines and 2 placer mines over 1928.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver prices for 1904 to 1915 are from the report of the Director of the Mint and represent the equivalent value per fine ounce based on average price and average rate of exchange; for 1916 and 1917, dealers' buying price, New York; for 1918, early estimated average price furnished by the Bureau of the Mint; for 1919, dealers' buying price, New York; for 1920 to 1922, New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper prices for 1904 to 1915 are those at New York; for 1916 and later years, weighted average price, for each year, of all grades of primary metal sold by producers. The lead prices for 1904 to 1915 are those at New York; for 1916, outside spot quotations, New York; for 1917 and later years, weighted average price, for each year, of all grades of primary metal sold by producers. The zinc prices for 1904 to 1914 are those at St. Louis; for 1915 and later years, weighted average price, for each year, of all grades of primary metal sold by producers.

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[1] Work on manuscript completed March, 1931.

[2] Published data on the metal resources of New Mexico are scanty. The mine report series of Mineral Resources, of which this chapter forms a part, have been published annually since 1904. Annual reports of the Director of the Mint begin with the year 1880. Professional Paper 68 of the U. S. Geological Survey, published in 1910, is a most valuable reference book covering the whole State. The Report of the Appraisal of Mining Properties of New Mexico, by J. R. Finlay, for the State Tax Commission, Santa Fe, 1921–22, contains valuable notes. Additional references are given in the section of this chapter, "Review by counties and districts," pp. 739 to 759.

Prices of silver, copper, lead, and zinc, 1904–1929

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1904	$0.58	$0.128	$0.043	$0.051	1917	$0.824	$0.273	$0.086	$0.102
1905	.61	.156	.047	.059	1918	1.00	.247	.071	.091
1906	.68	.193	.057	.061	1919	1.12	.186	.053	.073
1907	.66	.20	.053	.059	1920	1.09	.184	.08	.081
1908	.53	.132	.042	.047	1921	1.00	.129	.045	.05
1909	.52	.13	.043	.054	1922	1.00	.135	.055	.057
1910	.54	.127	.044	.054	1923	.82	.147	.07	.068
1911	.53	.125	.045	.057	1924	.67	.131	.08	.065
1912	.615	.165	.045	.069	1925	.694	.142	.087	.076
1913	.604	.155	.044	.056	1926	.624	.14	.08	.075
1914	.553	.133	.039	.051	1927	.567	.131	.063	.064
1915	.507	.175	.047	.124	1928	.585	.144	.058	.061
1916	.658	.246	.069	.134	1929	.533	.176	.063	.066

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1904–1929, in terms of recovered metals

Year	Mines producing			Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Total		Fine ounces	Value	Fine ounces	Value
1904	80	24	104	102,339	18,476.00	$381,930	214,553	$124,441
1905	52	21	73	145,629	15,359.56	317,510	369,192	225,207
1906	52	19	71	207,691	14,174.80	293,019	491,127	333,966
1907	104	23	127	219,992	15,962.88	329,982	705,544	465,659
1908	108	26	134	135,434	14,452.37	298,757	405,044	214,673
1909	111	17	128	164,156	11,585.38	239,491	397,783	206,847
1910	85	23	108	191,865	23,337.26	482,424	843,987	455,753
1911	85	20	105	232,699	36,900.84	762,808	1,354,540	717,906
1912	119	26	145	1,352,286	37,947.57	784,446	1,536,701	945,071
1913	108	20	128	2,217,660	42,663.17	881,926	1,631,273	985,289
1914	115	24	139	2,232,853	56,680.79	1,171,696	1,777,445	982,927
1915	148	26	174	2,797,072	70,680.96	1,461,105	2,005,531	1,016,804
1916	191	19	210	3,870,950	66,877.47	1,382,480	1,766,274	1,162,208
1917	177	15	192	4,576,827	51,478.64	1,064,158	1,394,365	1,148,957
1918	119	9	128	4,749,784	33,030.02	682,791	782,421	782,421
1919	86	6	92	2,155,998	31,717.36	655,656	837,418	937,908
1920	93	6	99	2,250,718	23,234.61	480,302	768,042	837,166
1921	40	9	49	611,576	9,521.26	196,822	571,899	571,899
1922	74	17	91	1,576,920	19,964.02	412,693	752,240	752,240
1923	104	16	120	3,111,050	26,689.12	551,713	747,127	612,644
1924	86	10	96	3,040,652	24,803.56	512,735	795,070	532,697
1925	92	12	104	3,358,566	26,561.40	549,073	735,124	510,176
1926	116	12	128	3,825,894	19,630.72	405,803	450,934	281,383
1927	102	10	112	3,442,184	29,241.87	604,483	890,083	504,677
1928	93	6	99	4,073,974	32,912.41	680,360	827,793	484,259
1929	113	8	121	4,506,807	35,176.46	727,162	1,121,546	597,784
Total, 1904–1929	------	-------	------	55,151,576	789,060.50	16,311,325	24,173,056	16,390,962

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1904–1929, in terms of recovered metals—Continued

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1904	4,972,170	$636,438	3,122,872	$134,283	13,493,835	$688,186	$1,965,278
1905	6,126,025	955,660	1,510,209	70,980	15,142,254	893,393	2,462,750
1906	7,028,670	1,356,533	2,987,369	170,280	17,292,655	1,054,852	3,208,650
1907	10,990,015	2,198,003	3,809,881	201,924	750,085	44,255	3,239,823
1908	6,112,630	806,867	873,763	36,698	3,576,516	168,096	1,525,091
1909	5,393,146	701,109	5,029,767	216,280	13,085,945	706,641	2,070,368
1910	4,614,386	586,027	4,320,841	190,117	18,088,129	976,759	2,691,080
1911	4,057,040	507,130	2,966,222	133,480	10,237,176	583,519	2,704,843
1912	34,030,964	5,615,109	5,494,018	247,231	13,566,637	936,098	8,527,955
1913	56,308,706	8,727,850	3,946,364	173,640	16,523,161	925,297	11,694,002
1914	59,307,925	7,887,954	1,763,641	68,782	18,403,392	938,573	11,049,932
1915	76,788,366	13,437,964	4,542,361	213,491	25,404,064	3,150,104	19,279,468
1916	92,747,289	22,815,833	8,214,189	566,779	36,570,649	4,900,467	30,827,767
1917	105,568,000	28,820,064	9,108,804	783,357	30,200,000	3,080,400	34,896,936
1918	98,264,563	24,271,347	8,398,239	596,275	24,050,324	2,188,579	28,521,413
1919	51,150,541	9,514,000	2,886,513	152,985	7,594,644	554,409	11,814,958
1920	54,400,691	10,009,727	2,869,525	229,562	10,013,580	811,100	12,367,857
1921	14,267,338	1,840,487	678,601	30,537	228,000	11,400	2,651,145
1922	31,937,207	4,311,523	3,012,223	165,672	4,496,806	256,318	5,898,446
1923	61,356,802	9,019,450	3,832,427	268,270	16,496,000	1,121,728	11,573,805
1924	74,691,436	9,784,578	3,634,511	290,761	20,759,200	1,349,348	12,470,119
1925	76,427,825	10,852,751	6,420,060	558,545	18,492,300	1,405,415	13,875,960
1926	81,642,379	11,429,933	6,960,366	556,829	24,104,800	1,807,860	14,481,808
1927	74,251,863	9,726,994	16,052,855	1.011,330	59,603,000	3,814,592	15,662,076
1928	89,854,646	12,939,069	15,610,501	905,409	62,406,000	3,806,766	18,815,863
1929	97,717,262	17,198,238	22,260,811	1,402,431	68,910,000	4,548,060	24,473,675
Total, 1904–1929	1,280,007,885	225,950,638	150,306,933	9,375,928	549,489,152	40,722,215	308,751,068

Gold and silver produced at placer mines in New Mexico, 1904–1929

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1904	7,228.39	$149,424			$149,424
1905	4,805.34	99,335	662	$404	99,739
1906	1,296.81	26,807	195	133	26,940
1907	935.56	19,340	173	114	19,454
1908	1,122.20	23,198	153	81	23,279
1909	1,064.73	22,010	162	84	22,094
1910	1,262.30	26,094	374	202	26,296
1911	905.29	18,714	162	86	18,800
1912	818.79	16,926	140	86	17,012
1913	380.27	7,861	90	54	7,915
1914	1,410.22	29,152	330	182	29,334
1915	447.09	9,242	55	28	9,270
1916	537.74	11,116	72	47	11,163
1917	589.16	12,179	92	76	12,255
1918	150.83	3,118	21	21	3,139
1919	239.89	4,959	33	37	4,996
1920	105.84	2,188	20	22	2,210
1921	400.59	8,281	61	61	8,342
1922	190.21	3,932	39	39	3,971
1923	204.05	4,218	30	24	4,242
1924	176.04	3,639	27	18	3,657
1925	97.62	2,018	13	9	2,027
1926	129.98	2,687	45	28	2,715
1927	280.97	5,808	32	18	5,826
1928	65.16	1,347	17	10	1,357
1929	79.82	1,650	4	2	1,652
Total, 1904–1929	24,924.89	515,243	3,002	1,866	517,109

GOLD

The mine production of recoverable gold in New Mexico in 1929 was valued at $727,162, compared with $680,360 in 1928. San Miguel County produced 47.18 per cent of the total in 1929, Hidalgo 30.19 per cent, Grant 18.62 per cent, and Catron 2.1 per cent. Copper ore yielded 49.18 per cent of the total, lead-zinc ore 47.42 per cent, and dry and siliceous ore 2.8 per cent. Placer mines yielded less than 1 per cent.

SILVER

The mine production of recoverable silver in New Mexico in 1929 amounted to 1,121,546 fine ounces, valued at $597,784, compared with 827,793 fine ounces, valued at $484,259, in 1928. San Miguel County produced 42.05 per cent of the total, all from the lead-zinc ore from the Pecos mine in the Willow Creek district; Grant County 35.47 per cent, chiefly from the Central district; Hidalgo County 15.18 per cent, chiefly from the copper ore of the Lordsburg district; Catron County 3.6 per cent, from the Mogollon district; and Socorro County 1.3 per cent, all from the Magdalena district.

Lead-zinc ore from Grant and San Miguel Counties yielded 65.37 per cent of the total silver; copper ore, chiefly from Grant and Hidalgo Counties, 24.1 per cent; dry and siliceous ore, chiefly from Catron and Hidalgo Counties, 4.8 per cent; and lead ore, chiefly from Dona Ana, Grant, Hidalgo, and Socorro Counties, 3.9 per cent.

COPPER

The mine production of recoverable copper in New Mexico in 1929 amounted to 97,717,262 pounds, valued at $17,198,238, compared with 89,854,646 pounds, valued at $12,939,069, in 1928. Of the total in 1929, 95 per cent was produced in Grant and Hidalgo Counties, chiefly from the operations of the Santa Rita mines in the Central district, Grant County, and from the Eighty-Five mine in the Lordsburg district, Hidalgo County. San Miguel County, third in order of output, yielded 2.7 per cent from the lead-zinc ore of the Pecos mine. Copper ore yielded 95.2 per cent and lead-zinc ore 4.4 per cent of the total.

LEAD

The mine production of recoverable lead in New Mexico in 1929 amounted to 22,260,811 pounds, valued at $1,402,431, compared with 15,610,501 pounds, valued at $905,409, in 1928. The chief lead-producing districts were the Willow Creek district, San Miguel County; the Central district, Grant County; the San Simon district, Hidalgo County; and the Magdalena district, Socorro County. Lead-zinc ore yielded 81.8 per cent of the total and lead ore 12.8 per cent.

ZINC

The mine production of recoverable zinc in New Mexico in 1929 amounted to 68,910,000 pounds, valued at $4,548,060, compared with 62,406,000 pounds, valued at $3,806,766, in 1928. The chief zinc-producing districts in 1929 were the Willow Creek in San Miguel County and the Central in Grant County. Other producing zinc districts were the Magdalena district, Socorro County, and the Swartz district, Grant County.

Zinc concentrates produced in 1929 amounted to 79,113 tons, containing as shipped 2,003.90 ounces of gold, 185,084 ounces of silver, 1,897,771 pounds of copper, 2,441,574 pounds of lead, and 82,981,738 pounds of zinc. The average content in zinc was therefore 52.4 per cent.

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1929, by counties, in terms of recovered metals

County	Mines producing			Ore (short tons)	Gold (lode and placer)	Silver (lode and placer)	
	Lode	Placer	Total			Fine ounces	Value
Catron	2	-------	2	438	$15,287	40,437	$21,553
Dona Ana	5	-------	5	2,340	----------	9,516	5,072
Grant	37	4	41	4,161,397	135,394	397,771	212,012
Guadalupe	1	-------	1	16,344	----------	1,653	881
Hidalgo	13	-------	13	93,072	219,528	170,244	90,740
Lincoln	1	-------	1	6	25	1,606	856
Luna	6	-------	6	453	244	1,666	888
Otero	11	-------	11	6,231	7,365	1,730	922
Rio Arriba	1	-------	1	3	----------	137	73
Sandoval	2	-------	2	113	19	90	48
San Miguel	1	-------	1	216,809	343,064	471,619	251,373
Santa Fe	4	3	7	1,269	3,064	2,486	1,325
Sierra	13	1	14	543	2,883	6,105	3,254
Socorro	11	-------	11	5,745	289	15,060	8,027
Torrance	4	-------	4	2,001	----------	1,413	753
Valencia	1	-------	1	43	----------	13	7
	113	8	121	4,506,807	727,162	1,121,546	597,784
Total, 1928	93	6	99	4,073,974	680,360	827,793	484,259

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Catron	15,187	$2,673	------------	------------			$39,513
Dona Ana	28,665	5,045	326,238	$20,553	------------	------------	30,670
Grant	88,538,239	15,582,730	8,044,858	506,826	22,926,000	$1,513,116	17,950,078
Guadalupe	1,500,000	264,000	------------	------------	------------	------------	264,881
Hidalgo	4,285,114	754,180	1,047,715	66,006	------------	------------	1,130,454
Lincoln	391	69	1,000	63	------------	------------	1,013
Luna	2,585	455	40,700	2,564	------------	------------	4,151
Otero	155,489	27,366	267,000	16,821	------------	------------	52,474
Rio Arriba	165	29	------------	------------	------------	------------	102
Sandoval	10,000	1,760	------------	------------	------------	------------	1,827
San Miguel	2,641,000	464,816	11,439,000	720,657	45,730,000	3,018,180	4,798,090
Santa Fe	183,455	32,288	------------	------------	------------	------------	36,677
Sierra	7,989	1,406	133,030	8,381	------------	------------	15,924
Socorro	184,483	32,469	961,270	60,560	254,000	16,764	118,109
Torrance	160,500	28,248	------------	------------	------------	------------	29,001
Valencia	4,000	704	------------	------------	------------	------------	711
	97,717,262	17,198,238	22,260,811	1,402,431	68,910,000	4,548,060	24,473,675
Total, 1928	89,854,646	12,939,069	15,610,501	905,409	62,406,000	3,806,766	18,815,863

MINING INDUSTRY

The output of ore from metal mines in New Mexico in 1929 was 4,506,807 tons, 432,833 tons more than that in 1928. The output in 1928 was the largest mined and milled in any year except the record output of 4,576,827 tons in 1917 and 4,749,784 tons in 1918. The value of the gold recovered ($727,162) in 1929 was the largest since

1917 but was still below the annual values from 1911 to 1917, inclusive, when the Mogollon gold and silver mines at Mogollon and the Aztec gold mine at Baldy were active producers. The quantity of silver recovered (1,121,546 ounces) was also the largest since 1917 but was still below the annual output from 1911 to 1917, inclusive. The quantity of copper produced in 1929 was surpassed only by the war production of 1917 and 1918. The quantities of lead and zinc produced were the highest recorded in the history of mining in the State.

The American Metal Co.'s Pecos mine at the junction of Willow Creek and Pecos River, San Miguel County, entered the producing list in 1927 as the largest single producer of gold, silver, lead, and zinc in the State and continued to hold that rank in 1928 and 1929. The output of this mine and other zinc-producing mines in New Mexico gave the State a recoverable zinc production in 1929 of 68,910,000 pounds, compared with 136,351,734 pounds in Montana, 103,019,485 pounds in Utah, 91,350,807 pounds in Idaho, and 58,861,000 pounds in Colorado.

Since 1912 the largest mine in New Mexico in point of yearly tonnage treated and of reserves has been the Chino Mines at Santa Rita, a large porphyry low-grade copper deposit mined by steam shovels. In 1929 the tonnage removed from this mine to the company's concentrating plant at Hurley was 3,973,300 dry tons, equivalent to a daily average of 10,886 tons, compared with 3,596,144 tons and 9,852 tons, respectively, in 1928. Prospect drilling for further exploration of ground to the south of the Sierra ore body added to reserves 20,000,000 tons of steam-shovel ore averaging better than 1 per cent copper. The underground work from the Estrella 661-foot man shaft was extended 7,442 feet in 1929 in preparation for mining part of the ore body by underground caving methods.

The Eighty-Five mine at Lordsburg, Hidalgo County, the third largest producing mine in New Mexico in 1929, was nonproducing 130 days of the year, owing to the underground flow of hot water on the 1,650-foot level which flooded all the openings below the 1,350-foot level. Other producers in the Lordsburg district in 1929 were the Anita, Atwood, and Bonney. The Lordsburg district furnishes highly siliceous copper-gold-silver ore for use at the Calumet & Arizona copper smelter at Douglas, Ariz., and the American Smelting & Refining Co.'s copper plant at El Paso, Tex.

At Mogollon a small production was made; experiments were conducted in the use of the flotation process. From 1890 to 1926 this district was a very important contributor to the silver and gold production of the State. In the Magdalena district, once an important zinc and lead producer, the Ozark flotation mill remained idle; production from the district was made by lessees. Lessees continued to ship copper smelting ore from the Tyrone copper properties of the Burro Mountain branch of the Phelps Dodge Corporation; company operations ceased late in 1928.

The principal mining district in point of value of metals produced and variety of types of mines was the Central district, Grant County, including Hanover, Fierro, Santa Rita, Vanadium, Bayard, and Georgetown. In addition to the Chino copper mine, other producing properties in the Central district were the Empire Zinc Co.'s zinc mine at Hanover, with its 300-ton flotation mill; the Black Hawk Consolidated Mines Co.'s 150-ton custom selective flotation mill and zinc-lead and copper-silver mines at Hanover; the Peru zinc mine at Hanover, with its 300-ton custom selective flotation mill at Wemple; the Asarco Mining Co.'s Ground Hog zinc-lead-copper-silver mine at Vanadium; and the Hanover Bessemer Iron & Copper Co.'s iron and copper mines at Fierro. East of Santa Rita, in the Swartz district, the Royal John mill, remodeled in 1927 to include flotation equipment and operated for a short time in 1928, was operated for a time in 1929. In the Pinos Altos district, north of the Central district, small placer-mining operations and intermittent lode mining were continued. At Silver City, west of the Central district, iron-manganese ore was mined from Boston Hill and Chloride Flat.

In Colfax County the Aztec gold mine on Mount Baldy was idle. In Dona Ana County lessees continued to ship smelting ore from the Organ district, and fluorspar ores were ground at Mesilla Park. In Lincoln County development work was done in the Red Cloud district. In Luna County small shipments of smelting ore were made from the Florida Mountains, Tres Hermanas, and Victorio districts, but the Cooks Peak district was idle. In Otero County substantial shipments of smelting ore were made from the Orogrande and High Rolls districts. In the High Rolls district much location and development work was done in 1929. Small lots of smelting ore, totaling 543 tons, were shipped from Sierra County mines.

Continuation of the high price for copper allowed continuation of shipments of siliceous copper ore from the "Red Beds" near Pastura, Guadalupe County, and near Scholle, Torrance County.

Molybdenum ore continued to be mined and milled on Sulphur Creek, Taos County.

The placer output from three districts in New Mexico—the Pinos Altos in Grant County, the Golden in Santa Fe County, and the Pittsburg in Sierra County—amounted to 79.82 fine ounces of gold and 4 fine ounces of silver.

ORE CLASSIFICATION

Ore sold or treated in New Mexico in 1929, with content in terms of recovered metals

Source	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	200	60.44	279	1,580	2,024	------------
Dry gold and silver ore	4,050	914.53	50,942	140,338	58,604	------------
Dry silver ore	608	2.52	2,806	11,386	12,354	------------
	4,858	977.49	54,027	153,304	72,982	------------
Copper ore	4,114,187	17,300.12	270,385	92,995,631	67,864	------------
Copper-lead ore	2,367	1.10	19,989	152,308	986,545	------------
Lead ore	16,265	138.68	43,995	68,057	2,849,620	------------
Lead-zinc ore	306,042	16,679.25	733,146	4,347,962	18,213,800	58,245,000
Zinc ore	63,088	------------	------------	------------	70,000	10,665,000
	4,501,949	34,119.15	1,067,515	97,563,958	22,187,829	68,910,000
Total, lode mines	4,506,807	35,096.64	1,121,542	97,717,262	22,260,811	68,910,000
Total, placers	------------	79.82	4	------------	------------	------------
	4,506,807	35,176.46	1,121,546	97,717,262	22,260,811	68,910,000
Total, 1928	4,073,974	32,912.41	827,793	89,854,646	15,610,501	62,406,000

Ore sold or treated in New Mexico in 1929, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Grant	100	41.84	279	1,580	2,024	
Otero	100	18.60				
	200	60.44	279	1,580	2,024	
Total, 1928	3,029	895.47	197	632		
DRY GOLD AND SILVER ORE						
Catron	355	616.21	31,099	5,700		
Grant	83	16.80	433	1,617	1,120	
Hidalgo	3,597	261.20	18,806	132,764	57,484	
Sierra	15	20.32	604	257		
	4,050	914.53	50,942	140,338	58,604	
Total, 1928	59	198.15	9,341	234		
DRY SILVER ORE						
Grant	50	1.02	1,410	97	654	
Luna	154		377	2,299		
Sierra	156		313	800	11,700	
Socorro	248	1.50	706	8,190		
	608	2.52	2,806	11,386	12,354	
Total, 1928	3,928	71.82	16,566	93,302	51,599	
COPPER ORE						
Dona Ana	190		119	12,278		
Catron	83	123.30	9,338	9,487		
Grant	4,006,230	6,288.62	105,788	86,666,811	66,564	
Guadalupe	16,344		1,653	1,500,000		
Hidalgo	80,672	10,350.30	141,893	4,146,418		
Otero	4,962	337.68	1,426	138,489	1,300	
Rio Arriba	3		137	165		
Sandoval	113	.92	90	10,000		
Santa Fe	1,269	117.31	2,486	183,455		
Sierra	60	80.20	1,401	6,076		
Socorro	2,217	1.79	4,628	157,952		
Torrance	2,001		1,413	160,500		
Valencia	43		13	4,000		
	4,114,187	17,300.12	270,385	92,995,631	67,864	
Total, 1928	3,733,442	16,481.69	197,389	87,257,916	35,800	
COPPER-LEAD ORE						
Grant	2,365	1.10	19,972	152,074	985,973	
Sierra	2		17	234	572	
	2,367	1.10	19,989	152,308	986,545	
Total, 1928						
LEAD ORE						
Dona Ana	2,150		9,397	16,387	326,238	
Grant	876	93.02	8,358	9,098	253,023	
Hidalgo	8,803	8.17	9,545	5,932	990,231	
Lincoln	6	1.21	1,606	391	1,000	
Luna	299	11.80	1,289	286	40,700	
Otero	1,169		304	17,000	265,700	
Sierra	310	13.79	3,770	622	120,758	
Socorro	2,652	10.69	9,726	18,341	851,970	
	16,265	138.68	43,995	68,057	2,849,620	
Total, 1928	13,211	155.13	51,584	136,997	3,196,233	

Ore sold or treated in New Mexico in 1929, by counties, with content in terms of recovered metals—Continued

LEAD-ZINC ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Grant	88,696	83.53	261,527	1,706,962	6,665,500	12,312,000
San Miguel	216,809	16,595.72	471,619	2,641,000	11,439,000	45,730,000
Socorro	537				109,300	203,000
	306,042	16,679.25	733,146	4,347,962	18,213,800	58,245,000
Total, 1928	249,233	15,044.99	552,699	2,365,565	12,291,869	53,055,000

ZINC ORE

County	Ore	Gold	Silver	Copper	Lead	Zinc
Grant	62,997				70,000	10,614,000
Socorro	91					51,000
	63,088				70,000	10,665,000
Total, 1928	71,072				35,000	9,351,000

METALLURGIC INDUSTRY

The markets for New Mexico ore and concentrates are all outside the borders of the State. Lead ores and concentrates are sold to the American Smelting & Refining Co.'s lead plant at El Paso, Tex., and to the Copper Queen lead plant at Douglas, Ariz. Copper ore and concentrates are sold to the American Smelting & Refining Co.'s copper plant at El Paso, to the Copper Queen copper smelter at Douglas, and to the Calumet & Arizona copper plant at Douglas. In the past some copper ore has gone to the American Smelting & Refining Co.'s copper plant at Hayden, Ariz. Zinc ore and concentrates are shipped to the United States Zinc Co.'s natural-gas retort plant at Amarillo, Tex.; to the Mineral Point Zinc Co.'s producer-gas retort plant at Depue, Ill.; to the Illinois Zinc Co.'s retort plant at Peru, Ill.; to the Ozark Smelting & Mining Co.'s zinc-pigment plant at Coffeyville, Kans.; to the American Metal Co.'s natural-gas retort plant at Blackwell, Okla., and producer-gas retort plant at Langeloth, Pa.; and to the Empire Zinc Co.'s zinc oxide plant at Canon City, Colo. Iron ore and iron-manganese ore go to Pueblo, Colo., and manganese ore goes to Birmingham, Ala.

The Grubnau Chemical Co.'s Wetherill grate zinc oxide plant at Waldo, N. Mex., remained idle.

Active metallurgical plants in New Mexico in 1929 were the copper flotation concentrator of the Chino Mines at Hurley, with a capacity of 12,000 tons in 24 hours, operated at 10,886 tons daily average; the Pecos zinc-lead-copper-silver-gold-iron selective flotation mill near Glorieta, with a capacity of 600 tons, operated at 594 tons daily average; the Peru zinc-lead-copper-silver-gold-iron selective flotation mill at Wemple, with a capacity of 300 tons, operated at a daily average ranging from 150 to 200 tons; the Empire Zinc Co.'s zinc-iron selective flotation mill at Hanover, with a capacity of 300 tons, operated at 120 tons daily; the Black Hawk zinc-lead-copper-silver-gold-iron selective flotation mill near Hanover, with a rated capacity of 150 tons, operated at 125 to 162 tons daily; the Carbon Hill flotation mill near Steins, with a capacity of 50 to 100 tons, operated for a short time; the Royal John zinc-lead-copper-silver selective flotation mill, 28 miles east of Santa Rita, with a capacity of 60 tons, operated at 35 tons daily during the period of operation; and the Hanover Bessemer Iron & Copper Co.'s magnetic separation (magnetite from gangue) plant at Fierro, with a capacity of 1,200 tons, operated at 560 tons daily.

Inactive plants in 1929 were the Aztec amalgamation-concentration gold mill at Baldy, with a capacity of 50 tons; the Carnahan zinc-lead-silver selective flotation mill at Carnahan, Santa Fe County, with a capacity of 50 tons; the Ozark zinc-lead-copper-silver-gold-iron selective flotation mill at Kelly, with a capacity of 200 tons; the Empire Zinc Co.'s zinc-lead-iron magnetic separation plant at Hanover, with a capacity of 250 tons; the American zinc-lead-silver-gold-iron selective flotation plant at Hachita, with a capacity of 200 tons; and the Burro Mountain branch (Phelps Dodge) copper concentrator at Tyrone (former capacity 2,000 tons), now partly dismantled.

Mine production of metals in New Mexico in 1929, by methods of recovery

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Concentrates smelted	[1]258,078	22,901.16	832,618	88,997,543	18,965,994	68,645,000
Ore smelted	156,506	12,195.48	288,924	8,719,719	3,294,817	265,000
Placer		79.82	4			
		35,176.46	1,121,546	97,717,262	22,260,811	68,910,000
Total, 1928		32,912.41	827,793	89,854,646	15,610,501	62,406,000

[1] From 4,350,301 tons of ore concentrated.

Gross metal content of New Mexico concentrates produced in 1929, by classes of concentrates

Class of concentrates	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Copper	152,038	6,219.91	91,964	88,172,902		
Copper-lead	24,573	14,874.00	536,361	3,945,030	17,645,202	5,246,203
Lead	2,354	13.55	53,098	77,452	2,457,224	505,309
Zinc	79,113	2,003.90	185,084	1,897,771	2,441,574	82,981,738
	258,078	23,111.36	866,507	94,093,155	22,544,000	88,733,250
Total, 1928	225,096	21,617.64	684,299	85,987,302	16,562,909	79,383,428

Mine production of metals from concentrating mills in New Mexico in 1929, by counties, in terms of recovered metals

County	Ore treated	Concentrates and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Catron	110	11	69.91	4,028	1,000		
Grant	4,124,972	187,396	6,233.53	349,463	86,351,962	6,729,000	22,915,000
Hidalgo	8,260	826	2.00	7,357	2,981	786,294	
San Miguel	216,809	69,830	16,595.72	471,619	2,641,000	11,439,000	45,730,000
Sierra	150	15		151	600	11,700	
	4,350,301	258,078	22,901.16	832,618	88,997,543	18,965,994	68,645,000
Total, 1928	3,922,191	225,096	20,519.08	625,670	81,575,407	13,360,679	62,067,000

Gross metal content of New Mexico crude ore shipped to smelters in 1929, by classes of ore

Class	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	200	60.80	279	1,761	2,278	----------
Dry gold and silver ore	3,940	844.62	46,914	151,512	106,127	----------
Dry silver ore	458	2.52	2,655	11,504	1,315	----------
Copper ore	140,887	11,150.12	189,002	9,209,873	135,801	----------
Copper-lead ore	2,367	1.10	19,989	217,582	1,096,166	----------
Lead ore	8,005	136.68	36,638	91,833	2,310,615	134,650
Lead-zinc ore	558	----------	----------	----------	164,800	266,552
Zinc ore	91	----------	----------	----------	----------	61,786
	156,506	12,195.84	295,477	9,684,065	3,817,102	462,988
Total, 1928	148,783	11,454.90	201,966	9,198,835	2,588,616	463,990

Mine production of metals from New Mexico crude ore shipped to smelters in 1929, by counties, in terms of recovered metals

County	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Catron	328	669.60	36,409	14,187	----------	----------
Dona Ana	2,340	----------	9,516	28,665	326,238	----------
Grant	36,425	292.40	48,304	2,186,277	1,315,858	11,000
Guadalupe	16,344	----------	1,653	1,500,000	----------	----------
Hidalgo	84,812	10,617.67	162,887	4,282,133	261,421	----------
Lincoln	6	1.21	1,606	391	1,000	----------
Luna	453	11.80	1,666	2,585	40,700	----------
Otero	6,231	356.28	1,730	155,489	267,000	----------
Rio Arriba	3	----------	137	165	----------	----------
Sandoval	113	.92	90	10,000	----------	----------
Santa Fe	1,269	117.31	2,486	183,455	----------	----------
Sierra	393	114.31	5,954	7,389	121,330	----------
Socorro	5,745	13.98	15,060	184,483	961,270	254,000
Torrance	2,001	----------	1,413	160,500	----------	----------
Valencia	43	----------	13	4,000	----------	----------
	156,506	12,195.48	288,924	8,719,719	3,294,817	265,000
Total, 1928	148,783	11,454.90	201,966	8,279,239	2,249,822	339,000

REVIEW BY COUNTIES AND DISTRICTS

CATRON COUNTY

Mogollon district.[3]—The Mogollon or Cooney silver-gold-copper mining district is in the southwestern part of Catron County, 78 miles by highway and 52½ miles in an air line northwest of Silver City, which has always been the supply point for the district. In recent years, however, a highway has been built connecting the district with Clifton, Ariz., 37½ miles in an air line southwest. The difficulty and cost of transportation of supplies into and of products out of the district during its early development and principal years of productivity—1885 through 1925—were met by the use of concentration methods, the most successful of which (after 1903) was gravity concentration and cyanidation of the concentrates. Since the closing, in January, 1926, of the Little Fanney 200-ton cyanidation mill (the last mill to operate in the district), development has not been extensive, and production has been limited to shipments direct to smelters of high-grade silver-gold ore and silver-gold-copper ore, principally from the Johnson group. In 1928 and 1929 experiments in the use of the flotation process were made at the Little Fanney mill. In 1929 part of the Little Fanney 1,100-foot vertical shaft was retimbered, the mill was overhauled, and gravity concentration tables and flotation cells were installed. Some development work was done at the Deadwood group and at the Trilby group.

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[3] Scott, David B., Ore Deposits of the Mogollon District: Trans. Am. Inst. Min. and Met. Eng., vol. 53, 1920, pp. 289–310; Kidder, S. J., Mining Methods in Mogollon District, N. Mex.: Trans. Am. Inst. Min. and Met. Eng., vol. 72, 1925, pp. 529–549; Ferguson, H. G., Geology and Ore Deposits of the Mogollon Mining District, N. Mex.: U. S. Geol. Survey Bull. 787, 1927, 100 pp.

Mine production of gold, silver, copper, and lead in Mogollon or Cooney district, Catron County, N. Mex., 1904–1929, in terms of recovered metals [1]

Year	Ore	Gold	Silver	Copper	Lead	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	
1904	11, 276	$61, 880	79, 014	422, 308	------------	$161, 763
1905	15, 534	97, 158	240, 943	295, 175	------------	290, 180
1906	16, 076	127, 907	268, 567	------------	------------	310, 533
1907	20, 698	105, 413	418, 338	150, 000	------------	411, 516
1908	19, 546	116, 418	278, 939	------------	------------	264, 256
1909	23, 945	111, 464	249, 413	46	49	241, 167
1910	50, 514	304, 210	595, 669	------------	------------	625, 871
1911	102, 219	531, 358	1, 067, 038	1, 873	1, 862	1, 097, 206
1912	101, 361	524, 858	1, 093, 158	184	386	1, 197, 197
1913	115, 739	619, 886	1, 306, 766	4, 418	1, 217	1, 409, 912
1914	136, 124	629, 102	1, 410, 327	------------	590	1, 409, 035
1915	119, 710	509, 165	1, 301, 059	------------	2, 426	1, 168, 916
1916	118, 257	373, 068	1, 008, 483	858	3, 232	1, 037, 084
1917	111, 934	258, 620	722, 642	414	1, 593	854, 327
1918	56, 452	119, 710	302, 902	235	282	422, 690
1919	56, 531	148, 136	382, 800	9, 521	------------	578, 643
1920	41, 895	125, 631	329, 489	582	2, 050	485, 045
1921	48, 870	126, 791	310, 774	------------	------------	437, 565
1922	48, 106	142, 133	322, 460	------------	------------	464, 593
1923	47, 644	179, 351	398, 714	------------	------------	506, 296
1924	72, 736	230, 960	618, 094	------------	------------	645, 083
1925	52, 118	163, 322	449, 699	------------	------------	475, 413
1926	976	12, 444	28, 404	24, 400	------------	33, 584
1927	89	4, 678	3, 591	------------	------------	6, 714
1928	81	4, 189	16, 800	17, 000	------------	16, 465
1929	438	15, 287	40, 437	15, 187	------------	39, 513
Total, 1904–1929	1, 388, 869	5, 643, 139	13, 244, 520	942, 201	13, 687	14, 590, 567

[1] In reports prior to 1921 the production for the Mogollon district will be found under Socorro County.

Wilcox district.—South of Mogollon, in section 8, T. 12 S., R. 18 W., a small Ellis ball mill was installed; 140 feet of drifts and crosscuts were driven in 1929 on the Corona de Oro prospect, opened by a shaft 50 feet deep and by two adits, one 300 feet and one 65 feet long.

COLFAX COUNTY

Mount Baldy district (Baldy, Elizabethtown, Therma).—Mining in the vicinity of Mount Baldy began in 1866 or 1867 with the sluicing of gold gravels in the creeks which radiate from the mountain and form Moreno River and Ute Creek, upper sources of Cimarron River. Production of placer gold through 1929 has been $3,000,000 or more, the heaviest production being in the 10 years immediately following discovery. In 1904–5 dredging was attempted in the Moreno River Valley.

The Aztec lode mine, on a spur of Mount Baldy, was discovered in 1868 and in a few years made an estimated output of $1,250,000 to $1,500,000. It was then abandoned until 1912. Between 1912 and 1920 it produced $1,680,718 in gold-silver bullion (fineness 0.856 to 0.889 gold and 0.142 to 0.105 silver) and $243,079 (mostly gold) in concentrates. Shortly after the discovery of "bonanza" ore in 1914 the cost of producing gold was as low as $2 an ounce, but in 1919 it rose to $13.50 owing to the large amount of timbering required and to other operating difficulties.[4] From 1920 to 1925, inclusive, the mine was operated by lessees in a desultory manner with occasional production, and in 1926–27 the owner—the Maxwell Land Grant Co.—repaired the workings, reopened old stopes, and operated the 50-ton amalgamation-concentration mill for nine months in 1927. In February, 1928, the mill was operated at the rate of about 25 tons a day until November 1, when mining of ore ceased. The mine was not operated in 1929.

Mine production of gold, silver, copper, and lead in Mount Baldy district, Colfax County, N. Mex., 1904–1929, in terms of recovered metals [a]

Year	Ore	Gold		Silver (lode and placer)	Copper	Lead	Total value
		Lode	Placer				
	Short tons			*Fine ounces*	*Pounds*	*Pounds*	
1904	380	$3,638	$90,639	67	----------	----------	$94,316
1905	13	445	31,994	181	----------	----------	32,549
1906	----------	----------	14,492	93	----------	----------	14,555
1907	----------	----------	11,914	83	----------	----------	11,969
1908	----------	----------	11,274	66	----------	----------	11,309
1909	83	1,705	16,037	127	----------	----------	17,808
1910	93	3,433	9,588	261	----------	2,182	13,258
1911	2,306	31,547	9,860	1,254	5,587	----------	42,770
1912	3,025	27,316	8,385	634	6,243	----------	37,121
1913	3,222	15,588	4,550	254	1,147	134	20,475
1914	2,860	63,129	4,930	577	11,083	154	69,858
1915	2,673	350,745	2,631	2,483	14,092	787	357,138
1916	6,064	417,258	5,039	2,803	447	----------	424,251
1917	10,180	342,994	5,739	2,381	4,784	930	352,081
1918	10,031	258,034	2,133	1,880	4,619	----------	263,188
1919	10,557	238,656	3,885	1,634	----------	----------	244,371
1920	5,637	81,722	1,634	607	----------	----------	84,018
1921	----------	5,361	3,447	52	----------	----------	8,860
1922	3,730	76,341	1,472	570	----------	----------	78,383
1923	2,315	48,725	1,811	430	592	----------	50,975
1924	----------	242	2,303	15	----------	----------	2,555
1925	2,000	51,688	970	432	----------	----------	52,958
1926	1,572	18,748	1,851	175	250	----------	20,743
1927	6,328	32,962	2,155	353	1,687	----------	35,538
1928	3,000	18,052	424	145	----------	----------	18,561
Total, 1904–1929	76,069	2,088,329	249,157	17,557	50,531	4,187	2,359,608

[a] No production reported for 1929.

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[4] Chase, C. A., and Muir, Douglas, The Aztec Mine, Baldy, N. Mex.: Trans. Am. Inst. Min. and Met. Eng., vol. 68, 1923, pp. 270–281. See also Finlay, J. R., Report of Appraisal of Mining Properties of New Mexico, Santa Fe, State Tax Commission, 1921–22; Lee, W. T., The Aztec Gold Mine, Baldy, N. Mex.; Contributions to Economic Geology, 1915, Part I: U. S. Geol. Survey Bull. 620, 1916, pp. 325–330.

DONA ANA COUNTY

Organ district.—In 1929 production from Dona Ana County was by lessees who worked the dumps of the Bennett-Stephenson, Excelsior, Memphis, and Torpedo lode mines near Organ. All the ore was shipped direct to the El Paso smelter; it consisted chiefly of lead-silver ore.

Mine production of gold, silver, copper, lead, and zinc in Dona Ana County, N. Mex., 1904–1929, in terms of recovered metals

Year	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1904	5,580	----------	24,101	40,000	1,581,488	----------	$87,103
1905	6,566	$6,710	21,776	96,058	327,707	30,000	52,150
1906	16,220	----------	34,051	434,000	1,207,193	----------	175,727
1907	6,084	6	25,612	776,125	675,189	----------	207,920
1908	3,090	----------	9,283	21,150	379,697	----------	23,660
1909	2,816	248	16,975	10,600	772,023	----------	43,650
1910	2	----------	15	----------	705	----------	39
1911	5	----------	111	353	1,561	----------	173
1912	78	17	1,790	6,685	26,129	----------	3,397
1913	155	30	1,232	10,189	9,557	----------	2,774
1914	451	927	3,564	78,180	29,897	----------	14,462
1915	1,599	2,426	8,335	241,749	19,170	----------	49,859
1916	2,615	503	7,948	206,187	34,696	106,679	73,144
1917	417	98	4,705	16,121	162,965	----------	22,391
1918	6,076	109	45,661	110,676	1,616,479	114,000	198,251
1919	1,856	----------	4,726	319,323	29,981	----------	66,276
1920	1,407	44	4,779	168,853	120,100	12,852	46,971
1921	47	----------	676	----------	20,000	----------	1,576
1922	43	----------	413	----------	12,576	----------	1,104
1923	25	----------	----------	----------	----------	14,000	952
1924	55	----------	300	8,893	2,064	----------	1,531
1925	221	----------	2,684	1,313	55,400	----------	6,868
1926	2,462	104	5,131	12,377	235,200	----------	23,855
1927	218	77	1,862	1,923	71,651	----------	5,899
1928	872	14	3,959	39,000	105,897	----------	14,088
1929	2,340	----------	9,516	28,665	326,238	----------	30,670
Total, 1904–1929	61,300	11,313	239,205	2,628,420	7,823,563	277,531	1,154,490

GRANT COUNTY[5]

Burro Mountain district (*Tyrone*).[6]—The Azure Leasing Co. shipped 10,800 tons of siliceous ore, carrying nearly 3 per cent copper, to Douglas, Ariz. As the result of two months' work lessees on the Copper Mountain group shipped several hundred tons of nearly 4 per cent copper ore. The property of the Burro Mountain branch (Tyrone) of the Phelps Dodge Corporation was not operated in 1929, but the Copper Queen copper smelter received several thousand tons of siliceous copper ore from the Burro Mountain branch which had been mined by lessees before underground pumping was discontinued at the Tyrone properties.

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[5] For a description of the geology of Bear Mountain, Burro Mountain, Chloride Flat, Fierro, Fleming, Georgetown, Hanover, Lone Mountain, Pinos Altos, and Santa Rita see Paige, Sidney, U. S. Geol. Survey Geol. Atlas U. S., Silver City folio (No. 199), 1916.

[6] Paige, Sidney, Copper Deposits of the Tyrone District, N. Mex.: U. S. Geol. Survey Prof. Paper 122, 1922.

Mine production of gold, silver, copper, and lead in Burro Mountain district, Grant County, N. Mex., 1904–1929, in terms of recovered metals [1]

Year	Ore	Gold	Silver	Copper	Lead	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	
1904	18,421	------	------	973,231	------	$124,574
1905	45,110	------	------	1,804,416	------	281,489
1906	66,285	------	------	2,608,005	------	503,345
1907	59,069	------	------	2,163,810	------	432,762
1908	20,097	$271	387	801,841	------	106,319
1909	36,037	284	2,160	1,160,838	------	152,316
1910	2,632	421	1,769	80,205	------	11,562
1911	681	558	3,623	28,089	------	5,989
1912	286	------	63	51,583	------	8,550
1913	100	2	19	15,155	------	2,362
1914	9,804	------	739	285,014	------	38,316
1915	18,505	------	3,558	1,406,286	------	247,904
1916	270,325	1,426	23,491	8,392,329	------	2,081,396
1917	490,679	5,354	41,523	14,574,355	------	4,018,368
1918	607,899	5,960	50,323	17,100,044	------	4,279,994
1919	188,670	2,129	16,275	6,101,102	------	1,155,162
1920	231,559	2,160	27,656	6,605,669	------	1,247,748
1921	171,505	2,357	18,184	4,496,124	------	600,541
1923	50,563	21	724	2,374,163	------	349,617
1924	3,846	------	------	2,665,093	------	349,127
1925	7,542	------	664	1,890,662	------	268,935
1926	1,403	445	2,476	678,250	20,000	98,545
1927	851	873	4,993	250,687	------	36,544
1928	6,640	523	1,805	889,347	------	129,645
1929	16,728	1,158	3,724	1,085,131	------	194,126
Total, 1904–1929	2,325,237	23,942	204,156	78,481,429	20,000	16,725,236

[1] No production reported for 1922.

Central district (*Bayard, Fierro, Georgetown, Hanover, Santa Rita*).—The Chino Mines of the Nevada Consolidated Copper Co., at Santa Rita, N. Mex., were operated continuously in 1929, yielding 3,973,300 tons of copper milling ore, all mined from open pits by steam and electric shovels. The Estrella ore shaft, which is to serve the mining operations for the ore bodies to be mined later by caving methods, was concreted to its full length of 661 feet. Underground development work was continued throughout the year from the man shaft and a total of 7,442 feet was driven. During 1930 permanent equipment will be installed in the man and material shaft, so as to permit greater facility in underground development work. The ore of the Chino Mines is low grade (between 1 and 2 per cent copper) and is mainly sulphide, but much of it is partly oxidized. The ore is transported from the mine by broad-gage railroad to the flotation concentration plant at Hurley, in which an average of 10,886 tons daily was milled in 1929. The full daily capacity of the seven units of this mill is 12,000 tons. The copper concentrates produced are smelted to blister copper at the El Paso (Tex.) copper plant of the American Smelting & Refining Co.

In the milling of the ore coarse crushing is done at the mine; in 1929 the gyratory crushers formerly in service at the Hurley coarse-crushing plant were erected in the Santa Rita coarse-crushing plant to follow the jaw crushers and break the ore more finely before it is loaded into ore cars and transported to Hurley. The equipment of the mill at Hurley, as of February, 1930, was as follows: Three 7-foot Symons cone crushers, fifteen 4 by 5 foot Hum-mer screens, three 4 by 7 foot Hum-mer screens, three 72 by 20 inch Garfield rolls, seven 7 by 10 foot rod mills, one 8 by 12 foot rod mill, seventeen 7 by 10 foot ball mills, seventeen 8 by 26⅔ foot Dorr classifiers, eight 8 by 26⅔ by 15 foot Dorr bowl classifiers, twenty-four (8 rows of 3 cells) 6½ by 27 foot Southwestern Engineering Co. rougher flotation cells, three 6½ by 18 foot Southwestern Engineering Co. cleaner cells (1 cell serves 2 rows of roughers), two 6½ by 9 foot Southwestern Engineering Co. cleaner cells (1 cell serves 1 row of roughers in experimental unit), four 14 by 14 foot Oliver filters, and one 48 by 20 foot and one 75 by 20 foot Dorr thickening tank.

The Twenty-Third Annual Report of the Nevada Consolidated Copper Co., for the year ended December 31, 1929, contains the following statement concerning the operations of the Chino Mines division and the revenue and costs of the combined Nevada, Ray, and Chino divisions:

> *Exploration and ore reserves.*—At Chino Mines prospect drilling for further exploration of the ground to the south of the Sierra ore body was begun in August, and by the end of the year 12 drill holes had been completed. A wider extent of ore than indicated by previous churn drilling had been disclosed by shovel operations in this vicinity in the banks of the pit, and the churn drilling already done shows that there is a major extension of the ore body to the south. This drilling program will be continued during the present year. A complete calculation of the additional ore shown by these holes has not been made and will not be undertaken until the amount and value of this ore extension has been more thoroughly determined by further drilling. From the results secured to date there is known to be an addition of approximately 20,000,000 tons of steam shovel ore averaging better than 1 per cent copper, and it is certain that the continuation of the drilling program will materially increase the tonnage of this newly developed ore.
>
> *Development and improvements at the mines.*—At Chino Mines the Estrella ore shaft, which is to serve future underground mining operations, was concreted to its full present depth of 661 feet. Underground development work was continued from the man shaft throughout the year and a total of 7,442 feet driven. The ground encountered to date has corroborated the previous churn drilling as regards the tonnage and value of the ore and is of a character suitable for mining by caving methods similar to those now used at Ray. The underground development drifts are now being continued to the south and east toward the territory in which the present churn drilling program has proven a major extension of the ore body, and the information secured from the driving of these development headings will be of value in ascertaining the extent and value of this newly discovered ore and in determining how much of it can be most economically removed by power shovels and how much it would be more profitable to extract by underground caving methods. During the coming year the man and material shaft will be provided with its permanent equipment so as to permit underground development work being carried on with greater facility than is possible with the temporary hoisting equipment now available.
>
> *Mining operations.*—At Chino Mines, where all ores were mined by power shovels, the mining cost for the year, exclusive of depreciation and taxes but including all other expenses of every nature, was 31.38 cents per ton, and the cost of stripping overburden was 49.61 cents per cubic yard
>
> The mining costs stated above do not include the usual charge made at all mines against each ton of ore produced covering prepaid development, stripping expense, or both. This charge for the year was at Chino Mines 45 cents per ton.
>
> *Construction and improvements at the mills.*—At Chino Mines remodeling of the Hurley concentrator was practically completed by the end of the year, except for the substitution of lower and smaller elevators for handling the product from the fine ore bin to the rod mills. The coarse crushing plant is now equipped with three 7-foot Symons cone crushers, three screen towers, and a dust collecting system. In the fine grinding department additional tube mills and classifiers have been installed, with their auxiliaries. The flotation department was made over last year. The gyratory crushers which were formerly in service at the Hurley coarse crushing plant have been erected in the Santa Rita coarse crushing plant following the jaw crushers in order to break the ore more finely before it is loaded into ore cars and transported to Hurley. The advantages that will be secured by the remodeling of the Hurley concentrator were evidenced in only a minor degree in the year's costs, for the reason that their benefits were not fully

realized until toward the close of the year, and further, because regular milling operations were interfered with by the construction and improvement work.

Milling operations in 1929.—At Chino Mines a total of 3,973,300 dry tons of ore, equivalent to a daily average of 10,886 tons, was milled through the Hurley concentrator during the year, at a milling cost of 59 cents per ton, which excludes depreciation and taxes but includes all other expenses.

Nevada Consolidated Copper Co.'s production in 1929.—The total quantity of ore produced from the Nevada, Ray, and Chino mines and treated during the year was 12,888,289 tons; of this total 12,803,387 tons, equivalent to a daily average of 35,078 tons, was treated at the concentrators, and 84,902 tons of crude ore was shipped direct to the smelters.

In addition to the company ores above stated, 1,033,042 tons of contract and other custom ores were milled, and 39,626 tons smelted at Nevada Mines.

The average grade of all company material milled was 1.257 per cent copper, and the average recovery in the form of concentrates was 84.74 per cent of the total copper content, corresponding to 21.30 pounds of copper per ton so treated.

The year's total net production of company copper from both concentrating and direct smelting ores was 266,274,918 pounds.

General.—At Chino Mines the work of remodeling and reconditioning the Hurley power plant was actively continued throughout the year. Six of the old boiler settings were dismantled and three new settings, consisting of three units of two boilers, each equipped with powdered coal apparatus, were completed and put in service. Five such units are required to provide sufficient boiler capacity for all requirements, and four more of the old boilers are now being taken down and reset. The jet condensers serving the 2,000 kw. and 6,000 kw. turbogenerators were replaced by surface condensers. At Santa Rita 8 secondhand heavy type locomotives, 20 secondhand 16-yard dump cars, and 34 new 20-yard dump cars were purchased, and the work of gradually converting the shovels from steam to electric continued. There has been a marked improvement in shovel efficiency since this additional equipment was received and placed in service. Improvements to provide a more adequate supply of water were as follows: At Santa Rita a new compressor was installed at the No. 700 well, which permitted the elimination of long air and water lines and consolidated in one plant all pumping equipment; at Hurley the Bolton wells were equipped with Kimball pumps and a 14-inch pipe line laid to the No. 2 dam. The Bolton wells are now delivering approximately 800 gallons a minute, which represents a most important addition to the Hurley water supply. Improvements for the accommodation of employees consisted of the completion of a large fireproof dormitory at Santa Rita, replacing the one that was burned down in the year 1927, the extension of the sewage system, and the reconditioning of some of the dwellings.

Statement of operations of the Nevada Consolidated Copper Co. for the year ended December 31, 1929

Operating revenues:		
Copper produced—266,274,918 pounds, at 16.752 cents		$44,606,143.81
Gold produced—59,482.294 ounces, at $20.539		1,221,722.99
Silver produced—242,107.700 ounces, at 53.126 cents		128,623.09
Operating expenses:		45,956,489.89
Mining, including stripping and development charge	$11,332,841.95	
Ore delivery—mine to mill	1,691,053.73	
Milling	6,156,861.15	
Treatment, freight, and refining	7,417,565.32	
Selling commission	332,614.68	
		26,930,936.83
Profit from operations		19,025,553.06
Miscellaneous income—net		1,942,749.90
Total income		20,968,302.96
Charges against income:		
Depreciation	$1,726,408.98	
Plant and equipment retirements	227,788.53	
Federal income tax and other charges	1,520,128.40	
		3,474,325.91
Net income to surplus		17,493,977.05

SURPLUS FROM OPERATIONS

Balance—Dec. 31, 1928	$19,870,194.77
Net income for year 1929 (without deduction for depletion)	17,493,977.05
	37,364,171.82
Distributions to shareholders	14,571,744.00
Balance—Dec. 31, 1929	22,792,427.82

In May, 1929, the Empire Zinc Co.'s 300-ton flotation mill at Hanover ceased to mill zinc tailings from the company's abandoned magnetic separation mill and thereafter handled run-of-mine zinc sulphide ore. The flotation product, zinc concentrates carrying more than 50 per cent zinc, was shipped to the company's zinc oxide plant at Canon City, Colo.

The Black Hawk Consolidated Mines Co.'s 150-ton selective flotation mill 1 mile south of Hanover, alongside the railroad and 400 feet from the Combination mine shaft, was operated continuously at the rate of 125 to 162 tons daily on zinc-lead-copper-silver ore from the Combination mine, supplemented by a few lots of custom ore from the Hanover and Magdalena districts. The equipment of this mill, as of April, 1930, was one jaw crusher, one 2-foot Symons cone crusher, one 6 by 6 foot Marcy ball mill, one 6 by 18 foot Dorr classifier, seven Southwestern Engineering Co. Air Lift flotation machines, one American 3-leaf (2 for zinc and 1 for lead) 6-foot diameter filter, and two Dorr thickening tanks. The heads for 1929 were lower than the average for 1928 published by Wright[7] as 2.37 ounces silver, 2.04 per cent lead, 0.44 per cent copper, and 12.04 per cent zinc.

The 2-unit Peru selective flotation mill (full capacity, 300 tons in 24 hours), built in 1928 at Wemple, 3½ miles northwest of Deming, was operated in 1929 at a daily average ranging from 150 to 200 tons; unit No. 1 was used on Peru Mining Co.'s zinc-lead ore from Hanover and unit No. 2 on Asarco Mining Co.'s zinc-lead ore from its Ground Hog mine at Hanover. The equipment of the mill consists of one Universal jaw crusher, one 2-foot Symons cone crusher, two 6 by 6 foot Marcy ball mills, two 6 by 23¼ foot Dorr classifiers, two 10-cell 18-foot and one 12-cell 18-foot Minerals Separation flotation machines, six Southwestern Engineering Co. 12-foot flotation machines, two 6 by 6 foot and one 8 by 3 foot Dorrco filters, and one 10 by 16 foot and two 10 by 25 foot Dorr thickening tanks. The products in 1929 were lead concentrates, which were sold to the lead plant at El Paso, Tex.; leady-zinc concentrates, which were sold to the zinc plant at Amarillo, Tex.; and lead-free zinc concentrates, which were sold to the Illinois Zinc Co., Peru, Ill.

Lessees on the Hanover-Emma-Modoc group of the Phelps Dodge Corporation at Fierro shipped siliceous copper oxidized ores to El Paso (Tex.) and to Douglas (Ariz.) smelters. A. Russell Davidson shipped similar ores from the Dewey and Schley properties at Fierro. The Hanover Bessemer Iron & Copper Co. shipped about 200,000 short tons of magnetite ore from its mines[8] at Fierro to the Colorado Fuel & Iron Co. at Pueblo, Colo., and intermittently shipped siliceous iron-copper oxidized smelting ore to El Paso, Tex. This mine is opened by a 6,000-foot adit and laterals therefrom. In 1929 the company did 1,272 feet of drifting, 1,972 feet of raising, 212 feet of deep-hole drilling, and 1,626 feet of diamond drilling. The magnetite iron ore was treated in 1929 by magnetic separation. The mill is equipped with 1 No. 9 and 1 No. 7½ Allis Chalmers gyratory crusher, 2 El Paso Foundry 36 by 60 inch shaking screens, 1 Traylor electric vibratory 36 by 60 inch screen, and 4 Ding minus ¼-inch to minus 2½-inch magnetic separation machines of the 3-belt type.

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[7] Wright, Ira L., The Small Mill Problem: Eng. and Min. Jour., Jan. 26, 1929, p. 150.

[8] Paige, Sidney, The Hanover Iron-Ore Deposits, N. Mex.; Contributions to Economic Geology, 1908, Part I: U. S. Geol. Survey Bull. 380, 1908, pp. 199-214.

In addition to mining zinc-lead ore from the Ground Hog mine the Asarco Mining Co. shipped copper-silver sulphide and copper-lead-silver sulphide ore from the Ground Hog and San Jose mines to the El Paso smelter. A car each of silver-lead ore from the Harry Eaton mine, 1½ miles from Bayard, and from the Forgotten mine near Santa Rita was shipped to the El Paso smelter. The Black Hawk Consolidated Mines Co. shipped copper-silver ore from the Lucky Bill mine to El Paso. Several hundred tons of copper ore from the McMiniter property at Fierro were shipped to El Paso. Two cars of copper-silver ore were shipped from the Rough Rider or Never Sweat property near Santa Rita. Lead-silver-gold smelting ore from the Silver King at Central and from the Three Brothers at Hanover was shipped to El Paso.

Mine production of gold, silver, copper, lead, and zinc in Central district, Grant County, N. Mex., 1904–1929, in terms of recovered metals

Year	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1904	21, 048	$5, 582	282	3, 264, 208	11, 977	----------	$424, 080
1905	20, 252	----------	8	3, 179, 206	----------	96, 424	501, 650
1906	39, 155	4	2, 524	3, 075, 001	235, 070	99, 656	614, 673
1907	57, 079	5, 659	36, 813	4, 994, 575	855, 358	73, 729	1, 078, 555
1908	41, 852	777	296	3, 994, 502	29, 122	251, 070	541, 231
1909	41, 456	816	1, 380	3, 348, 808	23, 256	203, 278	448, 856
1910	37, 008	----------	404	2, 679, 630	155	1, 285, 500	409, 955
1911	45, 584	104	8, 673	1, 413, 189	605, 978	290, 122	225, 156
1912	1, 136, 290	998	29, 586	29, 512, 812	2, 172, 676	2, 205, 824	5, 138, 779
1913	1, 948, 471	9, 697	12, 500	51, 695, 656	331, 440	2, 187, 266	8, 167, 144
1914	1, 934, 020	102, 971	42, 971	55, 222, 874	365, 079	3, 669, 513	7, 672, 759
1915	2, 395, 795	102, 379	73, 267	66, 581, 366	1, 542, 234	5, 628, 870	12, 561, 729
1916	3, 134, 791	133, 962	116, 953	74, 228, 606	2, 122, 797	7, 278, 575	19, 592, 956
1917	3, 668, 289	138, 873	121, 386	82, 200, 421	2, 250, 337	7, 398, 853	23, 627, 822
1918	3, 908, 816	128, 577	111, 175	77, 547, 300	2, 857, 887	8, 826, 967	20, 400, 099
1919	1, 789, 083	57, 280	34, 508	40, 358, 634	1, 283, 642	4, 299, 658	7, 984, 543
1920	1, 882, 172	68, 962	26, 190	44, 400, 088	925, 513	6, 134, 593	8, 838, 068
1921	362, 331	10, 439	9, 688	9, 138, 442	4, 422	95, 000	1, 203, 935
1922	1, 426, 783	24, 537	11, 326	28, 408, 184	352, 640	1, 333, 440	3, 966, 369
1923	2, 885, 711	68, 108	29, 264	54, 374, 770	1, 311, 141	13, 017, 000	9, 062, 131
1924	2, 859, 688	71, 121	38, 200	66, 824, 015	1, 183, 626	16, 921, 000	10, 045, 216
1925	3, 159, 167	97, 299	76, 547	68, 812, 280	2, 363, 260	15, 033, 000	11, 269, 879
1926	3, 633, 821	109, 335	86, 963	75, 219, 200	2, 611, 100	14, 327, 000	11, 977, 701
1927	3, 087, 823	98, 963	85, 963	66, 971, 008	1, 907, 476	10, 076, 000	9, 685, 941
1928	3, 723, 753	113, 507	143, 993	80, 238, 820	2, 359, 155	15, 089, 000	12, 809, 393
1929	4, 135, 864	131, 631	374, 398	87, 445, 648	7, 532, 318	22, 448, 000	17, 677, 723
Total, 1904–1929	47, 376, 102	1, 481, 581	1, 475, 258	1, 085, 129, 243	35, 237, 659	158, 269, 338	205, 926, 343

Chloride Flat district (*Silver City*).—No silver-lead ores were mined in 1929 from the Chloride Flat district adjoining Silver City, but iron-manganese ore [9] continued to be shipped from the Silver Spot or Kirchman mine to the Colorado Fuel & Iron Co.'s steel plant at Pueblo, Colo.

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[9] Jones, E. L., jr., Deposits of Manganese Ore in New Mexico; Contributions to Economic Geology, 1919, Part I: U. S. Geol. Survey Bull. 710, 1920, pp. 37–60; Wells, E. H., Manganese in New Mexico: New Mexico State School of Mines Bull., 1918.

Eureka (Hachita) district (see also Eureka district, Hidalgo County).—Several cars of lead-silver ore from the American group and one car of similar ore from the National group were shipped from Hachita to El Paso.

Gold Hill district.—The Wolverine Mining Co. unwatered and retimbered the workings of the Good Luck group at Gold Hill north of Lordsburg, drove 400 feet of new drifts, and shipped a car of silver-lead sulphide ore to El Paso. A small lot of silver-lead ore was mined and shipped to El Paso from a 15-foot inclined shaft on the Hunters prospect.

Pinos Altos district.[10]—Smelting ore, chiefly gold-silver ore, from the Buena Ventura, Copper Bell, Georgia, Kept Woman, and Three Brothers claims was shipped to smelters from Pinos Altos in 1929. A car of dry silver smelting ore was shipped from the Silver King. Surface deposits at Pinos Altos yielded, by hand rockers and pans, 33.60 crude ounces of placer gold which upon melting at the Denver Mint was reduced to 31.18 crude ounces, averaging 0.761 in gold fineness and 0.217 in silver fineness.

Mine production of gold, silver, copper, lead, and zinc in Pinos Altos district, Grant County, N. Mex., 1904–1929, in terms of recovered metals

Year	Ore	Gold		Silver	Copper	Lead	Zinc	Total value
		Lode	Placer					
	Short tons			*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1904	4,719	$49,660	$7,750	37,229	104,069	2,653	----------	$92,438
1905	6,348	31,442	10,943	39,585	103,469	----------	160,779	92,159
1906	14,074	89,674	2,290	83,566	328,788	----------	----------	212,245
1907	14,841	78,723	3,782	65,862	322,195	----------	----------	190,413
1908	1,451	8,548	1,479	8,941	34,514	3,953	----------	19,488
1909	38	2,083	3,584	1,377	6,200	418	----------	7,207
1910	20	1,372	2,494	223	269	2,226	----------	4,119
1911	355	1,406	4,043	5,616	3,232	4,063	16,773	9,968
1912	6,169	7,973	2,551	15,864	96,507	50,289	929,176	102,581
1913	3,643	29,162	1,646	28,276	100,555	83,067	366,056	87,626
1914	3,686	[a]114,181	[a]21,560	23,256	129,587	29,994	48,840	169,497
1915	7,024	31,823	1,979	19,884	377,463	130,638	454,710	172,463
1916	46,471	11,775	2,009	17,816	122,716	152,696	6,741,925	969,649
1917	45,993	7,731	3,153	10,803	49,945	80,989	5,556,892	607,189
1918	28,983	1,972	672	2,243	12,227	40,028	3,013,802	285,005
1919	2,912	5,044	1,074	2,524	14,452	20,906	267,671	32,281
1920	1,444	3,168	554	2,000	2,456	40,325	43,247	13,083
1921	----------	----------	2,368	37	----------	----------	----------	2,405
1922	7,880	19,142	2,079	55,820	26,193	673,847	----------	117,639
1923	2,968	12,988	1,300	17,404	68,129	90,471	44,000	47,899
1924	387	2,164	1,042	1,979	4,320	62,135	----------	10,069
1925	407	95	529	2,287	430	96,550	----------	10,672
1926	3,488	5,532	639	4,578	8,400	152,800	170,000	35,178
1927	5,219	5,332	693	4,591	12,206	142,492	130,000	27,524
1928	1,229	856	923	812	1,000	27,466	18,000	5,089
1929	234	1,760	491	2,180	4,557	8,047	----------	4,722
Total, 1904–1929	209,983	523,606	81,627	454,753	1,933,879	1,896,053	17,961,871	3,328,608

[a] Output from surface lode mines included with placer. Only a small quantity recovered by actual placer methods. Fineness so similar, separation not practicable.

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[10] Paige, Sidney, The Ore Deposits near Pinos Altos, N. Mex.; Contributions to Economic Geology, 1910, Part I: U. S. Geol. Survey Bull. 470, 1911, pp. 109-125.

Steeple Rock district (16 miles east of Duncan, Ariz.).—Assessment and development work was done in the Steeple Rock district in 1929, but no ore was shipped.

Swartz (or Carpenter) district (28 miles east of Santa Rita).—The Asarco Mining Co., Black Range unit, operated the Royal John mill (rebuilt in 1927) from January to August, 1929, when the mine and mill were returned to the owner. During the period of operation zinc-lead-silver ore was treated at the rate of 35 tons daily, making lead-silver concentrates and zinc concentrates. The equipment of the mill consists of one Blake crusher, one Symons disk crusher, one Hardinge ball mill, one Akins classifier, two 16-foot and two 8-foot Forrester flotation machines, one 4-foot 3-foot-diameter Oliver filter, two 18-inch by 4-foot Devereau agitating tanks, one 30-foot thickening tank, and two 3-inch Wilfley pumps.

White Signal district.—Several tons of gold ore from the Hassler prospect and a car of lead-silver-gold ore from the Lucky 7 prospect were shipped to smelters from the White Signal district in 1929.

GUADALUPE COUNTY

Throughout 1929 I. J. Stauber continued to ship oxidized copper ore from a surface deposit in sections 6 and 7, T. 7 N., R. 20 E., of the New Mexico principal meridian. The mine is developed by shallow shafts averaging 27 feet; the ore is extracted by drifts, leaving about 30 per cent as pillars. In 1929 the total quantity shipped was 16,344 tons averaging 4.75 per cent copper.

HIDALGO COUNTY

Eureka district (Hachita) (see also Eureka district, Grant County).—In 1929 the Apache Leasing Co. continued to ship lime rock from the Apache mine, south of Hachita, to the El Paso smelter. This ore in 1929 carried only 1.39 ounces of silver to the ton and 1.22 per cent of copper. Several cars of low-grade copper-silver ore were shipped from the Cochise property to the El Paso smelter.

Fremont district (Hachita) (see also Fremont district, Luna County).—Assessment work was done in 1929 on the Rattlesnake and Volney groups.

Gillespie (or Red Hill) district (Hachita).—In 1929 the Phelps Dodge Corporation took an option on the Red Hill mine, 28 miles south of Hachita, and shipped one car of lead-silver-gold oxidized ore to Douglas, Ariz.

Lordsburg district (including Pyramid and Virginia or Shakespeare districts).—Shipments of highly siliceous gold-silver-copper ore to smelters at Douglas, Ariz., and El Paso, Tex., were less in 1929 than in 1928 because of an underground flow of water in the Eighty-Five mine, the main producer of the district. The Pacific Copper Co. operated the Bonney mine throughout 1929; company and lessees' shipments totaling 18,190 tons of siliceous gold-silver-copper ore were sent to Douglas, Ariz. Other producers in 1929 were the Anita No. 1, Atwood, Misers Chest, and Robert E. Lee. A small lot of lead-silver ore was shipped from the Last Chance to the El Paso smelter. The annual report of the Calumet & Arizona Mining Co. and the Verde Central Mines (Inc.) for the year ended December 31, 1929, says of the Eighty-Five branch (at Valedon) of the Calumet & Arizona Mining Co.:

> During the year 1929 a total of 5,909 feet of development work was completed, as compared with 9,355.5 feet in the preceding year, a decrease of 3,446.5 feet. In addition to this development work there were 26,903.5 cubic feet of shaft and pump station excavated. In detail the work was as follows: Drifting, 2,168 feet; crosscutting, 2,328 feet; raising, 560.5 feet; sinking, 852.5 feet; stations, 26,903.5 cubic feet.
>
> Practically all the drifting and crosscutting was carried on in the western part of the mine in making connection with the Jim Crow shaft.
>
> Very little new ore was developed during the year. Some very promising ground was being developed on the 1,650 level, but work was stopped on this level April 4, 1929, due to a flow of water which flooded all the openings below the 1,350 level.
>
> The Jim Crow shaft was sunk to a depth of 1,117.5 feet or 852.5 feet for the year. Connections were made with the old workings on the 450 level, the 650 level, the 900 level, and the 1,050 level. No work was done in this shaft from April 15 to July 1.
>
> Ore mined in 1929 was 58,722 wet tons; ore shipped from leases was 89 wet tons; clay shipped from clay pit was 2,343 wet tons.
>
> The small production was due to the flooded condition of the mine and the time lost making shaft repairs. The mine was nonproducing for a period of 130 days during the year.
>
> The average grade of ore treated at the smelter at Douglas, Ariz., for the year was 2.87 per cent copper, as compared with 2.74 per cent copper in 1928.
>
> From January 1 to April 4 the amount of water pumped averaged 350 gallons per minute. On April 4 a flow of water was encountered on the 1,650 level, which amounted to an additional 800 gallons per minute, or a total flow of water from all levels of 1,150 gallons per minute. The water was hot and the flow continued for a period of 15 hours and then lessened somewhat. With the equipment at hand we were unable to handle this extra flow, and the water reached a point 9 feet above the sill of the 1,350 level. The mine was finally unwatered by using a combination of centrifugal pumps, a deep-well pump and 8 inch by 12 inch duplex double-action Prescott pump.
>
> As a permanent installation a centrifugal unit with a capacity of 600 gallons per minute and a Worthington triplex pump with a capacity of 150 gallons per minute were installed on the 1,350 level.
>
> A new pump station and sump were excavated on the 1,650 level, and a Worthington 6 inch by 18 inch horizontal duplex pump was installed. The original pumping equipment on the 1,650 level was reconditioned and is giving good service.
>
> The Emerald shaft was closed for a period of 15 days during the year for shaft repairs.
>
> Due to the increased load the two boilers and both turbines were in service all the year. Two power cables suitable for 2,200 volts were installed from the power plant to the 1,650 level.
>
> Due to the hot water encountered on the 1,650 level, it was necessary to install a ventilation system in order to do any work on the lower levels. A radial flow fan, built by the Green Fuel Economizer Co., was installed on the 1,650 level in December. The fan has only been in operation a short time, but results so far are very good.

Mine production of gold, silver, copper, and lead in Lordsburg district, Hidalgo County, N. Mex., 1904–1929, in terms of recovered metals [1]

Year	Ore	Gold	Silver	Copper	Lead	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	
1904	250	$1, 208	2, 580	18, 200	12, 000	$5, 550
1905	366	10	7, 584	48, 000	------------	12, 124
1906	1, 743	5, 168	27, 261	212, 601	------------	64, 737
1907	5, 645	8, 761	31, 303	463, 335	10, 522	122, 646
1908	7, 532	10, 617	9, 889	259, 079	11, 373	50, 534
1909	10, 690	25, 983	50, 154	589, 969	8, 862	129, 140
1910	29, 220	59, 798	130, 324	1, 627, 591	19, 662	337, 742
1911	46, 139	106, 648	182, 448	2, 455, 336	2, 157	510, 359
1912	55, 340	144, 859	275, 251	3, 155, 585	4, 562	835, 015
1913	31, 284	55, 234	154, 779	1, 601, 461	14, 572	397, 588
1914	38, 964	101, 080	232, 647	2, 614, 674	30, 049	578, 658
1915	92, 093	222, 848	374, 325	3, 890, 365	28, 723	1, 094, 795
1916	118, 966	267, 148	373, 074	4, 755, 179	30, 478	1, 684, 508
1917	99, 532	245, 607	295, 443	4, 261, 956	41, 442	1, 656, 130
1918	55, 015	130, 858	153, 236	2, 214, 996	17, 831	832, 464
1919	77, 002	175, 008	242, 733	3, 516, 457	53, 264	1, 103, 753
1920	55, 307	153, 461	182, 000	2, 695, 674	98, 312	855, 710
1921	11, 593	22, 987	35, 119	579, 295	13, 134	133, 426
1922	61, 291	114, 911	107, 511	3, 216, 585	102, 291	662, 287
1923	96, 587	216, 554	141, 538	4, 314, 122	46, 185	970, 024
1924	88, 472	192, 203	113, 591	4, 927, 878	40, 412	917, 094
1925	108, 219	222, 823	126, 781	5, 064, 140	69, 700	1, 035, 981
1926	97, 420	241, 954	126, 909	4, 762, 750	73, 400	993, 802
1927	93, 406	197, 333	77, 155	3, 933, 496	46, 381	759, 290
1928	91, 289	217, 548	104, 653	4, 625, 347	19, 638	945, 959
1929	83, 091	219, 359	159, 163	4, 248, 193	59, 080	1, 055, 597
Total, 1904–1929	1, 456, 456	3, 359, 968	3, 717, 451	70, 052, 264	854, 030	17, 744, 913

[1] In reports prior to 1920 the production for the Lordsburg district will be found under Grant County.

San Simon district (*Steins*).—The 100-ton flotation mill built in 1927–28 at the Carbon Hill holdings was operated part time in 1929. The product was lead-silver concentrates. The Phelps Dodge Corporation and other lessees on the Bradford prospect, including the Silver Hill group, 10 miles south of Steins, shipped several hundred tons of lead-silver-[zinc] sulphide ore to the lead plant of the Copper Queen smelter at Douglas, Ariz. The Phelps Dodge Corporation relinquished the lease early in 1930. Eighty-five feet of development work was done at the Granite Gap property in 1929.

LINCOLN COUNTY

No production was made in 1929 from the Jicarilla, Nogal, and Whiteoaks districts, former producers. A small shipment was made from the Cedar Creek district.

Cedar Creek district.—A small lot of lead-copper-silver-gold-[zinc] ore was shipped to the El Paso smelter from the Zinc Contact group, near Hollywood post office; the shipping point is Capitan.

Red Cloud or Gallinas Mountains district.—The Real Del Monte Metals Co., owner of the Conqueror claim and lessee of the Deadwood-Red Cloud group, retimbered the shaft for 300 feet and prepared to sink to 600 feet in order to drift and raise to the ore opened in a winze on the 300-foot level. Lead-silver ore taken out in development work was stored.

LUNA COUNTY

Cooks Peak district (*north of Deming*).—The Cooks Peak district, once a relatively prominent producing district as the following table indicates, remained idle in 1929.

Mine production of gold, silver, copper, lead, and zinc in Cooks Peak district, Luna County, N. Mex., 1904–1929, in terms of recovered metals [1]

Year	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1904	1,078		4,401		576,795		$27,355
1905	846		5,199		463,956		24,977
1906	1,133		7,519		627,544		40,883
1907	811	$12,713	4,739		592,151		47,225
1908	253		1,009		127,535		5,891
1909	695		4,317	46	597,488		27,943
1910	457		1,917	47	242,137		11,695
1911	45		200		32,638		1,575
1912	927		960		142,680	433,129	36,897
1913	1,271		1,248	1,395	255,901	695,697	51,189
1914	1,995	68	2,423	2,181	381,324	793,588	57,043
1915	1,352	7	432		64,382	647,210	83,506
1916	2,562		433		56,275	1,390,119	190,444
1917	2,330	20	3,602	99	272,140	1,067,853	135,340
1918	1,252	33	1,947	3,150	156,549	463,445	56,046
1919	122		745	941	26,473	31,575	4,717
1920	136	10	1,322	2,223	52,738	21,098	7,788
1922	81		72	1,130	9,087	24,228	2,106
1923	8		15	13	1,988		153
1924	454	70	1,658	573	152,199		13,432
1925	1,740	109	2,657	1,200	416,230	119,300	47,402
1926	319		492	242	106,500	42,000	12,011
1927	1,006	257	1,335	367	162,238		11,283
Total, 1904–1929	20,873	13,287	48,642	13,607	5,516,948	5,729,242	896,901

[1] No production reported for 1921, 1928, and 1929.

Florida Mountains district.—One car of copper-silver ore was shipped to El Paso from the Manganese Valley group.

Tres Hermanas district[11] (*Columbus*).—Several cars of copper-silver ore were shipped to El Paso, Tex., and Douglas, Ariz., from the Spar group. A small lot of lead-silver-gold ore from the Dorothy group and a car of lead-silver-gold ore from the Three Sisters group were shipped to El Paso.

Victorio district (*Gage*).—Several cars of lead-silver-gold ore were shipped to El Paso by a lessee on the Chance group, near Gage.

Mine production of gold, silver, copper, lead, and zinc in Victorio district (*Gage*), *Luna County, N. Mex., 1904–1929, in terms of recovered metals* [a]

Year	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1904	274	$1,695	2,047		76,465		$6,170
1906	620	413	2,876		186,000		12,971
1907	1,200	992	3,600		408,000		24,992
1909	183	290	2,460	1,069	85,418		5,381
1910	22	3	267		21,318		1,085
1911	180	104	883	1,598	66,250		3,753
1912	2,123	5,687	23,305		684,867	7,865	51,382
1913	3,895	11,085	40,416	58	902,781		75,227
1914	132	158	552		35,599		1,851
1915	216	457	1,476	2,320	53,958		4,147
1916	1,804	3,535	8,436		381,000		35,375
1917	1,505	5,191	11,301	220	428,907		51,449
1918	1,631	8,171	14,358		323,493		45,497
1919	1,728	4,926	10,438	538	356,775		35,626
1920	1,331	6,661	10,167	1,641	298,113		41,894
1921	676	1,488	4,709		144,467		12,698
1922	158	372	583		28,622		2,529
1923	468	1,300	2,195	1,028	64,930		7,796
1924	285	132	485		47,975		4,295
1925	609	823	2,833	1,000	116,600		13,075
1926	129	149	633		22,500		2,344
1927	28	45	224		7,398		638
1928	40	85	188		9,000		717
1929	278	230	1,004	284	27,000		2,516
Total, 1904–1929	19,515	53,992	145,436	9,756	4,777,436	7,865	443,408

[a] No production reported for 1905 and 1908.

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[11] Lindgren, Waldemar, The Tres Hermanas Mining District, N. Mex.; Contributions to Economic Geology, 1908, Part I: U. S. Geol. Survey Bull. 380, 1908, pp. 123–128.

OTERO COUNTY

High Rolls (Sacramento Mountains) district.—In 1929 Stewart & Holmes shipped more than 1,000 tons of highly siliceous lead-silver-copper oxidized ore from the Alamo group. This property, 7.6 miles from High Rolls, is opened by an 800-foot inclined shaft, 3,000 feet of adits, and 1,800 feet of drifts. Corrie & Warnock shipped several cars of copper ore from the Courtney property. The Adycupb Co., of Colorado Springs, Colo., did required location work on 242 claims and in addition sank a 200-foot inclined shaft on mining locations 7 to 9 miles south of High Rolls.

Orogrande district.—Lessees on the old By Chance mine at Orogrande shipped gold-silver-copper-iron mixed sulphide and oxidized ore in 1929 to the El Paso smelter. Mining was done by drifting and open cuts. A Huntington No. 5 roller mill was operated intermittently on gold ore from the Nancy Lee property and produced a small quantity of gold bullion.

Mine production of gold, silver, copper, and lead in Orogrande district, Otero County, N. Mex., 1904–1929, in terms of recovered metals [1]

Year	Ore	Gold		Silver (lode and placer)	Copper	Lead	Total value
		Lode	Placer				
	Short tons			*Fine ounces*	*Pounds*	*Pounds*	
1904	170	$1, 569	$1, 050	164	14, 400	----------	$4, 557
1905	20	41	1, 036	93	3, 600	----------	1, 696
1906	78	228	195	163	11, 166	----------	2, 689
1907	11, 319	14, 711	100	1, 829	555, 580	----------	127, 134
1908	21, 901	34, 215	1, 475	4, 205	710, 780	----------	131, 742
1909	143	157	100	29	6, 354	----------	1, 098
1910	536	2, 559	6, 022	2, 007	38, 858	5, 841	14, 857
1911	770	6, 718	----------	680	10, 406	739	8, 412
1912	2, 553	11, 005	2, 034	1, 011	119, 740	----------	33, 418
1913	15, 822	49, 805	42	6, 444	597, 580	1, 911	146, 448
1914	11, 009	38, 459	----------	5, 376	387, 211	2, 027	93, 010
1915	14, 930	54, 974	----------	6, 150	853, 257	----------	207, 412
1916	20, 195	39, 504	305	7, 403	1, 077, 492	638	309, 787
1917	15, 558	23, 504	737	4, 514	731, 894	----------	227, 768
1918	6, 210	5, 096	----------	2, 048	253, 405	----------	69, 735
1919	205	74	----------	25	4, 382	----------	917
1921	500	5, 230	----------	32	----------	----------	5, 262
1923	68	366	----------	190	666	14, 286	1, 620
1924	499	21	----------	397	4, 046	129, 286	11, 160
1925	217	715	----------	75	13, 300	----------	2, 656
1927	372	396	----------	60	7, 847	----------	1, 458
1928	2, 753	4, 104	----------	559	70, 368	----------	14, 564
1929	4, 837	7, 353	----------	1, 259	119, 699	----------	29, 091
Total, 1904–1929	130, 665	300, 804	13, 096	44, 713	5, 592, 031	154, 728	1, 446, 491

[1] No production reported for 1920, 1922, and 1926.

RIO ARRIBA COUNTY

Bromide district.—In 1929 a small lot of copper-silver ore was shipped to the Durango (Colo.) smelter from the Bromide mine.

SANDOVAL COUNTY

Cochiti (Bland) district.—The Cochiti district was reopened in 1929, and new development work totaled 532 feet. This district was formerly a silver-producing district; the ore was last treated in a 100-ton cyanidation plant.

Cuba district.—A car of copper-silver ore was shipped to the El Paso smelter from the Conglomerate property.

Jemez Springs district.—Several cars of copper-silver ore were shipped to the El Paso smelter from the Spanish Queen property near Jemez Springs.

SAN MIGUEL COUNTY

Willow Creek district (Tererro).—At the junction of Willow Creek and Pecos River is a copper-stained silicified outcrop which has been known since 1878. Subsequently, it has been known as the discovery location of the Katydid, Evangeline, and other mining claims which, as development proceeded, have been variously known as the Hamilton, Cowles, Goodrich-Lockhart, and Pecos mine. Before 1905 Cowles did some development work on the property but shipped no ore. By 1905 development consisted of a 180-foot shaft and a short adit. Between 1916 and 1925, the Goodrich-Lockhart Co. developed the property in part to the 400-foot level, sampled the ore bodies developed, and diamond-drilled laterally and vertically. In 1925 the American Metal Co. took over the management, development, and operation, built a 600-ton selective flotation mill in Alamitos Canyon, 6 miles by road from Glorieta station and 4 miles by railroad spur from Fox station on the Atchison, Topeka & Santa Fe Railway, and connected the mill and mine by a 12-mile aerial tram.

The mill has been operated continuously from the time it was first set in motion on January 20, 1927, through 1929, with only minor shutdowns for repairs. The ore minerals are sphalerite, galena, chalcopyrite, and pyrite, and the gangue is a sheared micaceous diorite. One of the chief problems in milling is to remove the sericite and talc; before the selective flotation process was developed this problem had kept the mine inactive and unsalable. The actual heads in 1929 averaged 0.100 ounce gold, 2.81 ounces silver, 3.67 per cent lead (wet assay), 1.02 per cent copper (wet assay), and 14.56 per cent zinc. From 216,809 dry tons treated in 1929 were made 52,724 tons of zinc concentrates, averaging 0.037 ounce gold, 2.73 ounces silver, 1.39 per cent lead (wet assay), 1.30 per cent copper (wet assay), and 52.22 per cent zinc, and 17,076 tons of lead-copper concentrates, averaging 0.869 ounce gold, 20.45 ounces silver, 36.62 per cent lead (wet assay), 6.17 per cent copper (wet assay), 14.02 per cent iron, and 11.41 per cent zinc.

The lead-copper concentrates were shipped in 1929 to the American Smelting & Refining Co.'s lead plant at El Paso. The zinc concentrates were shipped to the Blackwell Zinc Co.'s (American Metal Co.) natural-gas retort plant at Blackwell, Okla., and to the American Zinc & Chemical Co. (American Metal Co.) at Langeloth, Pa. Zinc residues from Blackwell went to El Paso, Tex., and from Langeloth to Chrome, N. J.

The ore is crushed at the mine by one 30 by 18 inch jaw crusher, two 6 by 10 inch gyratory crushers, and one set of 54 by 20 inch Garfield rolls. The mill is equipped with sampling equipment, three No. 75 Marcy mills, three Dorr Duplex 6-foot classifiers, twenty-four standard Wilfley tables, one hundred and twenty M. S. Sub A. 18-inch flotation cells, three 8 by 12 foot Oliver filters, and three 40 by 10 foot Dorr thickening tanks.

The power for both mine and mill is electric, made at the 3,000-kilowatt (two 1,500-kilowatt units) steam turbine plant adjacent to the mill. The fuel used is powdered New Mexico bituminous coal. Water for the mill is pumped from Pecos River, and the tailings from the mill are caught in a dam in Alamitos Canyon.

The mine is opened by an 837-foot vertical shaft and 25,464 feet of drifts and crosscuts, of which 219 feet of shaft and 11,740 feet of drifts and crosscuts were done in 1929. The mining method includes both the cut-and-fill system and square-sets. Native timber from the United States forest reserve is used for timbering.

Mine production of gold, silver, copper, lead, and zinc in San Miguel County, N. Mex., 1927–1929, in terms of recovered metals

Year	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1927	164, 874	$235, 766	509, 446	1, 989, 000	8, 706, 000	42, 445, 000	$4, 050, 139
1928	201, 013	309, 697	495, 930	2, 120, 000	10, 385, 000	46, 410, 000	4, 338, 436
1929	216, 809	343, 064	471, 619	2, 641, 000	11, 439, 000	45, 730, 000	4, 798, 090
	582, 696	888, 527	1, 476, 995	6, 750, 000	30, 530, 000	134, 585, 000	13, 186, 665

SANTA FE COUNTY

Los Cerrillos district.—In 1929 the shaft of the Evelyn Gold Copper group, 5½ miles north of Waldo station, was sunk to 247 feet and one car of copper-gold-silver oxidized ore was mined and shipped to the El Paso smelter. The ore carried 0.10 ounce gold and 0.50 ounce silver to the ton, 2.55 per cent copper, 83.4 per cent insoluble, 0.2 per cent zinc, 0.4 per cent sulphur, 3.5 per cent iron, and 0.8 per cent lime. One car of copper-gold-silver ore was shipped to the El Paso smelter from the Ready Cash property.

Mine production of gold, silver, copper, lead, and zinc in Los Cerrillos district, Santa Fe County, N. Mex., 1904–1929, in terms of recovered metals [1]

Year	Ore	Gold		Silver (lode and placer)	Copper	Lead	Zinc	Total value
		Lode	Placer					
	Short tons			*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1907	--------	--------	$111	--------	--------	--------	--------	$111
1908	--------	--------	217	--------	--------	--------	--------	217
1909	2, 821	$418	602	2, 285	1, 093	213, 558	4, 426	11, 772
1910	4, 617	499	1, 757	3, 300	5, 150	262, 023	74, 759	20, 258
1911	51	343	101	1, 915	4, 494	11, 178	--------	2, 524
1912	752	8	195	1, 040	8, 670	12, 511	10, 565	3, 566
1914	287	60	--------	779	7, 575	52, 948	89, 860	8, 146
1915	700	127	--------	426	1, 766	50, 638	14, 556	4, 837
1916	2, 546	148	--------	2, 175	--------	166, 304	334, 321	57, 853
1917	3, 118	23	--------	142	2, 579	17, 779	512, 628	54, 661
1918	172	--------	--------	--------	--------	11, 000	94, 572	9, 387
1922	40	--------	--------	--------	--------	8, 800	19, 840	1, 615
1926	807	4, 343	--------	1, 011	41, 800	24, 500	--------	12, 786
1927	1, 644	6, 572	--------	1, 120	71, 771	8, 635	--------	17, 153
1928	300	870	--------	205	12, 174	2, 466	--------	2, 886
1929	87	116	--------	34	3, 552	--------	--------	759
Total, 1904–1929	17, 942	13, 527	2, 983	14, 432	160, 624	842, 340	1, 155, 527	208, 531

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[1] No production reported for 1904–1906, 1913, 1919–1921, and 1923–1925.

New Placers district (*Golden, San Pedro*).—Several groups of lessees on the dumps of the San Pedro mine shipped 1,166 tons of copper-silver-gold ore to El Paso. The ore is hauled 12½ miles northwest to Hagan railroad station. This mine is part of the property of the Santa Fe Gold & Copper Co., which owns 33,479 acres of land, of which 279 acres are patented mining claims. When worked by the company from 1900 to 1917 the mine was opened by a 200-foot shaft and a 1,600-foot adit. In 1929 a lessee on the San Francisco prospect drove 100 feet of adit, making 200 feet of adit development, mined and shipped 16 tons of copper-silver-gold ore, and then abandoned the lease.

Placer mines in the San Pedro district in 1929 yielded 34.76 crude ounces of gold bullion, which after being melted at the Denver Mint weighed 32.97 ounces, containing 30.90 fine ounces of gold. Fineness of gold in three lots was 0.938, 0.923, and 0.953 and of silver in the respective lots, 0.047, 0.059, and 0.045.

Mine production of gold, silver, copper, lead, and zinc in New Placers district (Golden, San Pedro), Santa Fe County, N. Mex., 1904–1929, in terms of recovered metals

Year	Ore	Gold		Silver (lode and placer)	Copper	Lead	Zinc	Total value
		Lode	Placer					
	Short tons			*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1904	170	$1, 292	$4, 135	----------	2, 308	----------	----------	$5, 722
1905	180	2, 241	4, 002	42	----------	----------	----------	6, 269
1906	128	7, 143	6, 737	53	----------	----------	----------	13, 916
1907	21, 338	16, 748	1, 120	17, 635	1, 231, 260	----------	----------	275, 759
1908	7	242	1, 572	6	----------	----------	----------	1, 817
1909	10	453	1, 215	10	----------	----------	----------	1, 673
1910	122	3, 378	2, 505	59	----------	----------	----------	5, 915
1911	69	982	2, 258	717	12, 150	----------	----------	5, 139
1912	14, 583	10, 208	1, 107	13, 138	801, 893	----------	----------	151, 706
1913	29, 800	26, 746	129	22, 076	1, 798, 769	794	----------	319, 053
1914	23, 297	8, 980	1, 312	4, 944	285, 786	----------	----------	51, 036
1915	27, 013	41, 973	1, 567	23, 945	1, 703, 091	----------	----------	353, 721
1916	40, 137	66, 106	3, 112	29, 696	2, 153, 610	----------	----------	618, 546
1917	7, 024	7, 129	2, 155	6, 739	396, 828	----------	----------	123, 171
1918	3, 743	3, 981	313	5, 244	220, 846	17, 479	----------	65, 328
1919	125	1, 484	--------	642	3, 414	16, 623	----------	3, 719
1920	111	1, 130	--------	46	2, 598	----------	37, 555	4, 700
1921	----------	----------	2, 466	5	----------	----------	----------	2, 471
1922	9	20	224	27	2, 003	----------	----------	541
1923	105	717	970	298	23, 102	----------	----------	5, 328
1924	569	2, 553	294	1, 788	143, 152	5, 787	14, 400	24, 197
1925	5, 984	5, 321	519	10, 275	199, 770	249, 800	170, 000	75, 991
1926	6, 952	4, 061	197	37, 651	136, 000	1, 053, 166	1, 234, 000	223, 595
1927	15, 248	4, 719	2, 960	54, 037	46, 748	2, 199, 490	2, 446, 000	339, 554
1928	3, 252	3, 322	--------	6, 530	243, 042	96, 069	145, 000	56, 557
1929	1, 182	2, 309	639	2, 452	179, 903	----------	----------	35, 918
Total, 1904–1929	201, 158	223, 238	41, 508	238, 055	9, 586, 273	3, 639, 208	4, 046, 955	2, 771, 342

SIERRA COUNTY

Apache, Cuchillo Negro district (*Chloride*).—A 25-ton gravity concentration mill at Cuchillo was operated for a short time on a complex ore from the Dictator and Prospector's Delight claims, yielding a few tons of lead-copper-zinc-silver concentrates, which were sold to the lead plant of the Copper Queen smelter at Douglas, Ariz. Small lots of lead-silver and copper-silver ore were shipped to the El Paso smelter from the Central, Fluorine, Republic, Silver Monument, and Yeager properties.

Kingston district.—One car of lead-silver ore was shipped from the Sharp property.

Las Animas district (Hillsboro).—One car of gold-silver-copper ore was shipped to El Paso from the Empire-Bonanza mine, and one lot of gold-silver-copper ore was shipped to El Paso from the Copper Flat property.

Macho district (Lake Valley).—Several cars of lead-silver-gold ore were shipped by a lessee on the Anniversary group on Macho Creek 10 miles northwest of Nutt station.

Pittsburg district (Hot Springs).—One small lot of copper ore and one small lot of dry gold-silver ore were shipped to El Paso from prospects near Hot Springs. From August 1 to September 23 the Shandon Placer Mining Co. sluiced 500 cubic yards of stream and bench gravels on the Rio Grande River 25 miles north of Hatch, producing placer gold bullion which averaged 0.968 gold and 0.032 silver in fineness.

Sierra Blanca district.—Assessment work was done at the Log Cabin-Carbonate-Cockrobin prospect 17 miles northwest of Lake Valley.

Mine production of gold, silver, copper, lead, and zinc in Sierra County, N. Mex. 1904–1929, in terms of recovered metals

Year	Ore	Gold		Silver	Copper	Lead	Zinc	Total value
		Lode	Placer					
	Short tons			*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1904	1,295	$51,617	$22,979	17,055	16,700	----------	--------	$86,626
1905	3,513	51,164	47,878	8,760	46,664	----------	--------	111,666
1906	3,246	16,539	1,509	8,102	5,995	----------	--------	24,714
1907	700	7,629	595	2,250	5,425	9,548	--------	11,300
1908	680	16,039	1,979	8,589	12,874	6,075	--------	24,524
1909	4,294	10,450	--------	25,698	25,838	49,023	--------	29,280
1910	8,306	11,113	584	15,778	2,448	11,274	--------	21,024
1911	5,036	26,962	823	16,487	5,374	28,088	--------	38,459
1912	252	2,597	1,546	11,236	8,988	21,001	--------	13,481
1913	269	434	423	2,529	2,568	32,685	--------	4,221
1914	98	1,305	442	3,982	14,436	5,743	--------	6,093
1915	438	1,079	1,757	316	2,228	24,617	7,492	5,472
1916	935	1,468	--------	2,138	14,427	126,609	7,045	16,104
1917	619	1,470	331	8,712	11,828	80,116	--------	19,099
1918	801	568	--------	18,536	42,053	25,915	--------	31,331
1919	4,041	3,948	--------	67,658	31,661	49,679	--------	88,247
1920	6,957	15,896	--------	117,089	43,826	84,264	--------	158,328
1921	3,856	1,323	--------	77,366	1,395	40,934	--------	80,711
1922	9,965	2,708	--------	136,842	38,771	8,746	--------	145,265
1923	6,441	6,443	--------	80,814	61,469	12,842	--------	82,645
1924	42	527	--------	1,297	3,787	4,901	--------	2,284
1925	2,545	1,825	--------	23,090	6,300	38,930	--------	22,132
1926	19,658	4,592	--------	107,973	16,680	298,800	20,500	99,744
1927	1,022	8,621	--------	10,300	20,496	123,000	12,000	25,663
1928	500	3,485	--------	6,754	5,403	146,448	--------	16,708
1929	543	2,363	520	6,105	7,989	133,030	--------	15,924
Total, 1904–1929	86,052	252,165	81,366	785,456	455,623	1,362,268	47,037	1,181,045

SOCORRO COUNTY

Good Fortune district (40 miles west of Tularosa).—A car of copper-silver-gold ore was shipped to the El Paso smelter from the Bella Vista prospect; the property is opened by a 50-foot adit.

Magdalena district (Kelly, Magdalena).—A lessee on the Empire Zinc Co.'s Kelly mine shipped nearly 2,000 tons of lead-copper-silver oxidized ore to El Paso and several hundred tons of zinc-lead sulphide ore to the leaded-zinc oxide plant at Coffeyville, Kans. Two cars of lead-silver ore were shipped to El Paso as a result of a lessee's operations on one of the claims of the Germany group. One car of lead-silver ore was shipped to El Paso from the Gold King property. Several hundred tons of lead-silver ore was shipped from the Juanita mine to El Paso. A lessee shipped several hundred tons of silver-copper ore from the Waldo dump to El Paso and another shipped two cars of lead-silver ore from the South Juanita to El Paso. J. A. McDonald shipped several thousand tons of copper-silver sulphide ore and several cars of lead-silver sulphide ore to El Paso and several cars of zinc sulphide ore to Coffeyville, Kans., from the Nitt property. A car of zinc-lead sulphide ore from the Vindicator mine was shipped to Coffeyville, Kans. The Ozark Smelting & Mining Co.'s mine and 200-ton flotation mill remained idle in 1929.

Mine production of gold, silver, copper, lead, and zinc in Magdalena district, Socorro County, N. Mex., 1904–1929, in terms of recovered metals

Year	Ore.	Gold	Silver	Copper	Lead	Zinc	Total value
	Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1904	27, 998	$154	5, 024	3, 200	688, 209	13, 493, 835	$721, 257
1905	30, 411	--------	4, 800	320, 000	390, 000	14, 630, 051	934, 351
1906	35, 478	--------	2, 515	64, 560	238, 088	17, 044, 163	1, 067, 435
1907	3, 630	13	4, 406	24, 045	707, 981	676, 356	85, 158
1908	6, 319	72	460	2, 605	16, 073	3, 325, 446	157, 631
1909	30, 724	435	17, 925	170, 792	3, 085, 279	12, 878, 241	860, 051
1910	42, 232	468	65, 880	152, 181	3, 451, 228	16, 727. 870	1, 110, 529
1911	25, 840	352	42, 773	77, 448	2, 123, 039	9, 930, 281	694, 266
1912	22, 590	746	32, 792	69, 532	2, 192, 792	9, 962, 478	818, 473
1913	47, 647	3, 942	40, 212	278, 252	2, 198, 030	13, 267, 811	911, 069
1914	51, 595	2, 265	14, 436	214, 722	674, 205	13, 785, 176	768, 144
1915	75, 401	488	56, 897	1, 406, 789	2, 031, 297	18, 437, 218	2, 657, 209
1916	78, 669	2, 036	72, 877	993, 199	4, 421, 290	19, 312, 179	3, 187, 217
1917	100, 709	2, 186	137, 114	2, 690, 381	4, 885, 210	14, 716, 745	2, 770, 878
1918	56, 295	430	49, 835	585, 482	3, 033, 535	11, 501, 879	1, 456, 931
1919	13, 938	10	30, 117	599, 382	819, 566	2, 995, 740	407, 352
1920	17, 235	--------	18, 367	311, 663	873, 012	3, 764, 235	452, 110
1921	412	--------	155	------------	60, 711	133, 000	9, 537
1922	8, 304	207	6, 156	8, 063	923, 541	3, 119, 298	236, 046
1923	10, 117	455	15, 721	50, 388	1, 506, 829	3, 421, 000	358, 859
1924	11, 128	199	10, 643	94, 626	1, 636, 825	3, 823, 800	399, 219
1925	12, 356	1, 154	25, 073	82, 800	2, 434, 600	3, 170, 000	483, 042
1926	43, 414	606	14, 575	56, 714	1, 400, 200	8, 013, 300	730, 654
1927	41, 702	775	70, 478	173, 817	1, 637, 667	4, 430, 000	450, 199
1928	6, 798	1, 980	16, 183	128, 327	991, 207	339, 000	108, 095
1929	5, 726	285	15, 032	174, 483	961, 270	254, 000	116, 330
Total, 1904-1929	806, 668	19, 258	770, 446	8, 733, 451	43, 381, 684	223, 153, 102	21, 952, 042

Salinas Peak district.—Development work was done in 1929 at the Salinas Chief group in the Salinas Peak district, east of Engle and northwest of Tularosa.

TAOS COUNTY

Red River district.—At the Silver King group of the Buffalo-New Mexico Mines Co. on Placer Creek the 25-ton experimental mill was operated experimentally, yielding 1,716 pounds of salable gold-silver concentrates, which were shipped to the El Paso smelter. As this was the only producer in Taos County, and the management does not wish to have the contents of the concentrates published, the production in 1929 will be incorporated in this series in following years. Development at this property in 1929 consisted of assessment work, road improvement, surface work, and drifting and crosscutting underground. The Placer Creek & Black Mountain Mining Co. continued assessment and development work. The adit on this property is 1,400 feet long. Assessment work was done at the Champion group, the Silver Tip group, and the Willard group.

Sulphur Creek district.—The Molybdenum Corporation of America continued to mill molybdenum ore from the Phyllis group at the 20-ton flotation mill at the junction of Sulphur Creek and Red River above Questa.

TORRANCE COUNTY

Continuation of the high price for copper allowed continuation of mining in the "Red Beds" near Scholle. As a result 2,001 tons of 4.18 per cent copper ore carrying 0.70 ounce of silver to the ton was shipped in 1929. The 1,943 tons of ore shipped in 1928 averaged 5.00 per cent copper and 1 ounce of silver to the ton.

VALENCIA COUNTY

Diener district.—Assessment work was done at the Valencia copper prospects in sections 17, 18, 19, and 20, T. 11 N., R. 12 W., near Diener, 20 to 26 miles west of Grant.

Rio Puerco district.—The Cimarron Mining Co. shipped one car of copper ore from Rio Puerco station, northwest of Belen.

GOLD, SILVER, COPPER, AND LEAD IN TEXAS[1]

(MINE REPORT)

By Chas. W. Henderson

SUMMARY

The mine production of gold, silver, copper, and lead in Texas from 1920 to 1929 is shown in the following table. The total production of silver in Texas from 1885 to 1929, inclusive, is recorded as 22,383,284 ounces.

Mine production of gold, silver, copper, and lead in Texas, 1920–1929, in terms of recovered metals[1]

Year	Ore (short tons)	Gold	Silver		Copper		Lead		Total value
			Fine ounces	Value	Pounds	Value	Pounds	Value	
1920	56, 269	--------	511, 401	$557, 427	14, 435	$2, 656	--------	--------	$560, 083
1921	58, 527	--------	516, 766	516, 766	--------	--------	--------	--------	516, 766
1922	69, 420	--------	644, 980	644, 980	4, 2[illegible]0	579	8, 016	$441	646, 000
1923	78, 610	$802	811, 824	665, 696	4, 257	625	26, 605	1, 862	668, 985
1924	84, 744	--------	720, 739	482, 895	--------	--------	--------	--------	482, 895
1925	72, 737	--------	552, 000	383, 088	--------	--------	16, 000	1, 392	384, 480
1926	34, 042	2, 270	447, 237	279, 076	12, 620	1, 767	83, 890	6, 711	289, 824
1927	50, 759	8, 192	1, 034, 866	586, 769	21, 458	2, 811	487, 984	30, 743	628, 515
1928	76, 915	10, 115	1, 340, 622	784, 264	447, 792	64, 482	695, 570	40, 343	899, 204
1929	63, 872	26, 439	1, 020, 516	543, 935	341, 000	60, 016	849, 683	53, 530	683, 920

[1] Total production from 1885 to 1927 and prices used in calculating values are shown in the chapter of this series in Mineral Resources, 1927, Pt. I, pp. 477 and 478. See also Mineral Resources, 1912, Pt. I, p. 878.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1920 to 1922 is New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

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[1] Work on manuscript completed March, 1931.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1920	$1.09	$0.184	$0.080	$0.081	1925	$0.694	$0.142	$0.087	$0.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064
1923	.82	.147	.070	.068	1928	.585	.144	.058	.061
1924	.67	.131	.080	.065	1929	.533	.176	.063	.066

REVIEW BY COUNTIES

BREWSTER COUNTY

In 1929 a small lot of lead-silver ore (less than half a ton) was shipped from Alpine to the El Paso smelter for testing purposes.

CULBERSON COUNTY

In 1928, at the Hazel mine, the World Exploration Co. reconditioned the old buildings, constructed new ones, erected a 65-foot headframe and a 150-ton ore bin, and enlarged the old shaft to 4½ by 10½ feet in the clear, making a 3-compartment shaft to the 340-foot level of the old single-compartment 740-foot shaft. In 1929 the company continued underground development and continued to ship crude silver-copper ore to the El Paso smelter from January 1 to August 1. Development work in 1929 consisted of 624 feet of drifts, 148 feet of crosscuts, and 381 feet of raises, making in all 3,000 feet of drifts, 521 feet of crosscuts, and 958 feet of raises. The company started the erection of a 100-ton flotation mill, which was 85 per cent completed on January 1, 1930. The minerals in the ore are sulphides in a siliceous gangue. The Hazel mine was first opened in 1885 and was operated intermittently until 1917; it was then idle until 1927, when lessees began shipping from the dumps. The mine is 14 miles north of Van Horn.

A car of lead-copper-silver ore was shipped from the Pecos group north of Van Horn.

EL PASO COUNTY

At El Paso are the lead and copper plants of the American Smelting & Refining Co. As of December 31, 1929, these plants comprised 6 lead blast furnaces, with a total annual capacity of 350,000 tons, and 2 copper reverberatory furnaces and 3 copper converters, with a total annual capacity of 600,000 tons.

The Nichols electrolytic copper refinery, also at El Paso, was almost completed (90 per cent by December 15, 1929), under agreement entered into by the Phelps Dodge Corporation, the Calumet & Arizona Mining Co., and the Nichols Copper Co.[2]

HUDSPETH COUNTY

Allamoore district.—Eight miles northeast of Allamoore the Black Shaft mine, worked in a small way in the past, was reopened in May, 1929. Development work was started July 12. Approximately 1,000 feet of development was done in 1929, and 1,187 tons of ore, carrying

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[2] Robie, Edward H., A Trip Through the New Nichols Copper Refinery at El Paso, Tex.: Eng. and Min. Jour., vol. 129, January, 1930, pp. 5-10; Furnace and Casting Equipment of the New Nichols Refinery: Eng. and Min. Jour., vol. 129, January, 1930, pp. 73-76.

0.59 ounce silver to the ton and 3.19 per cent copper, was shipped to the El Paso smelter. One car of silver ore (carrying also lead) from the Mohawk property, two cars of silver ore (carrying also copper) from the Roundtree property, and two cars of copper ore from the St. Elmo property were shipped to the El Paso smelter from Allamoore.

Sierra Blanca district.—Two hundred tons of silver-copper ore was shipped to El Paso from the Bonanza property near Sierra Blanca.

PRESIDIO COUNTY

The American Metal Co., which has been operating the Presidio mine and cyanidation mill at Shafter since April, 1926, continued milling operations in 1929 at approximately the same daily tonnage as in 1928, but the heads in 1929 averaged 19.74 ounces silver to the ton, compared with 23.17 ounces in 1928.[3] According to a personal communication from R. Bosustow, manager for the American Metal Co., the property, originally known as the Bullis, was discovered in 1880. The Presidio Mining Co. was organized in 1883, and the company records show expenditures of $30,665.78 in 1883 and $16,022.99 in 1884. This company erected the first mill on the property, a small pan-amalgamation plant with a capacity of 50 tons a day. A company statement of ore milled, silver content, loss and yield by pan amalgamation, and costs of operation by years, 1883 to 1913, shows that the first yield (17,731 ounces) and the first sales ($16,050.04) of silver bars were in 1885, and that no sales were made in 1886–87, but that the yield and sales were continuous from 1888 to 1913. In 1913, on the same site and using the same stamps and part of the other equipment, the Presidio Mining Co. built a countercurrent decantation cyanide mill. Later, the company added concentration tables.

At the close of 1928 the American Metal Co. replaced the old coarse-crushing plant at the mine by a new one at the mill and replaced the old stamp battery with a new Symons cone crusher; the new equipment was put in operation in January, 1929.

The following table shows the total number of tons treated, silver content of mill heads (per ton and total), and recovery of silver (per cent and total).

Production of silver from the Presidio mine, 1885–1929

Period	Mill heads treated (short tons)	Silver content of mill heads (ounces)		Recovery of silver	
		Per ton	Total	Per cent	Ounces
1885–1912	450,000	25.84	11,628,000	81.68	9,497,750
1913–1926	720,000	12.00	8,640,000	83.66	7,228,224
1927	48,190	22.87	1,102,105	[a] 91.41	[a] 1,004,384
1928	57,475	23.17	1,331,696	91.04	1,212,340
1929	54,644	19.74	1,078,673	90.30	974,049
	1,330,309	17.88	23,780,474	....	19,916,747

[a] Using the company's 1927 report of 1,004,384 ounces of silver recovered gives 91.13 per cent recovery; using 91.41 per cent (Howbert and Gray, work cited, p. 6) as recovery gives 1,007,434 ounces of silver recovered.

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[3] Howbert, Van Dyne, and Gray, Fred E., Milling Methods and Costs at Presidio Mine of the American Metal Co. of Texas: Am. Inst. Min. and Met. Eng., Tech. Pub. 368, 1930; Howbert, Van Dyne, and Bosustow, Robert, Mining Methods and Costs at Presidio Mine of the American Metal Co. of Texas: Am. Inst. Min. and Met. Eng., Tech. Pub. 334, 1930.

The ore is found as a replacement of limestone beds and is oxidized and siliceous. The silver minerals contained in the ore are principally argentite and cerargyrite, the former predominating. The lead minerals, all of which are argentiferous, are chiefly cerussite and galena, with occasionally a little anglesite. The gold is free; most of the ore contains merely a trace, but occasional concentrations assay as high as 0.5 ounce to the ton.

The grinding capacity of the mill is 300 tons per day, but the agitation and settling capacity is sufficient for only 175 to 200 tons, depending on the grade of the ore; the mill treated an average of 150 tons in 1929. In 1929 the equipment consisted of one Telsmith model 8 A gyratory crusher, one Symons 3-foot cone crusher, one 3 by 5 foot Hum-mer screen, two El Paso Foundry 4½ by 18 foot tube mills, two Dorr 24-inch Duplex drag classifiers, nine Wilfley No. 6 tables, two Oliver 16-foot filters, four 14 by 28 foot and two 12 by 36 foot Pachuca agitation tanks, two Dorr 10 by 30 foot tray thickening tanks, two El Paso Foundry 10 by 30 foot agitation tanks, one 3½ by 3½ Merrill clarifying press of 22 frames, and one Crowe-Merrill vacuum-precipitation process with two 22-leaf Merrill presses. Because of the lime alkalinity the cyanide also dissolved much of the lead oxidized minerals, which with the silver were precipitated by the zinc dust, making a very high-grade precipitate of both lead and silver. These precipitates were shipped direct to the Selby refinery in California. The lead concentrates were shipped direct to the El Paso lead smelter. Recoveries in 1929 were as follows:

Average mill recoveries (per cent), Presidio mine, in 1929

Product	Weight	Recovery [1]		
		Silver	Gold	Lead
Heads	100.00	100.00	100.00	100.00
Tails	98.05	9.70	3.00	65.70
Precipitates	.10	62.60	57.50	1.50
Concentrates	1.85	27.70	39.50	32.80
Precipitates plus concentrates	1.95	90.30	97.00	34.30

[1] Recoveries include corrections based on smelter returns.

The mine is opened by two vertical shafts—the South shaft, 400 feet deep and in the western part of the mine, and the East shaft, 700 feet deep and 1,850 feet northeast of the South shaft. Old and new underground workings total more than 26 miles of drifts and crosscuts. Development footage in 1929 was 5,784 feet. In 1929 all work was done through the 400-foot shaft; an interior shaft has been sunk to the 500-foot level. The upper terminal of the aerial tram connecting the mine with the mill, which lies in a valley 1 mile east, is near the collar of the East shaft. The upper terminal is connected with the South shaft by surface narrow-gage tracks, over which 2-ton side-dump cars are hauled by gasoline locomotives.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN ARIZONA[1]

(MINE REPORT)

By C. N. Gerry and T. H. Miller[2]

SUMMARY

In 1929 the mines of Arizona produced gold, silver, copper, lead, and zinc valued at $155,567,133, the largest production since the war period and the largest production of the five metals for any State; copper represented nearly 94 per cent of the total value. The increase of $41,266,752 over the 1928 output was almost entirely the result of the large increase in the output of copper; increases, however, were also made in the output of the other four metals. As the average price of copper rose from 14.4 cents a pound in 1928 to 17.6 cents a pound in 1929, most of the large producers of copper increased their output considerably. The Calumet & Arizona, United Verde, Inspiration, United Verde Extension, Miami Copper, Magma, New Cornelia, Arizona Commercial, Night Hawk Leasing, and Iron Cap mining companies paid dividends (partly estimated) amounting to about $31,270,000. In addition, the Phelps Dodge Corporation, operating mines at Bisbee and Morenci, Ariz., and also in New Mexico and Mexico, paid $5,750,000, and the Nevada Consolidated Copper Co., operating mines at Ray, Ariz., McGill, Nev., and Santa Rita, N. Mex., paid $14,571,744.

The average value of the metals recovered from the ore, old tailings, slag, etc., increased from $4.93 a ton in 1928 to $5.93 in 1929; the average value in gold and silver decreased from 35 to 32 cents a ton.

The chief producing counties in 1929 in order of total value of metals recovered were Yavapai, Cochise, Gila, Pinal, Pima, and Greenlee, all large copper producers. Gold was recovered chiefly from Yavapai, Cochise, Pima, Pinal, Gila, and Mohave Counties. The increase in the total output of gold, the result of the larger output of copper ore, came chiefly from Yavapai, Cochise, and Gila Counties. Silver came largely from Yavapai, Cochise, and Pinal Counties. Lead was recovered chiefly from Gila, Santa Cruz, Cochise, Maricopa, and Pima Counties. Nearly all the zinc came from Santa Cruz County.

During the decade from 1920 to 1929 most of the gold was recovered from copper ore and from dry and siliceous ore. In recent years gold from copper ore has been gradually increasing, whereas gold from siliceous ore has been decreasing. In 1929 gold from siliceous ore was less than one-ninth that in 1920, and gold from copper ore was more than double that in 1920. Gold was also saved from lead ore and from mixed ores; very little came from placers. During the 10-year period, copper ore was the chief source of silver, with smaller amounts from siliceous ore and lead ore. Silver from copper ore increased from 1921 to 1926, decreased in 1927, and again increased in 1928 and 1929. Silver from dry and siliceous ore has been decreasing; although it increased slightly in 1927 and 1928, it declined markedly in 1929.

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[1] Work on manuscript completed March, 1931.

[2] The valuable assistance of Paul Luff and Jeannette Froiseth, of the Bureau of Mines, is acknowledged.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1920 to 1922 is New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1920	$1.09	$0.184	$0.080	$0.081	1925	$0.694	$0.142	$0.087	$0.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064
1923	.82	.147	.070	.068	1928	.585	.144	.058	.061
1924	.67	.131	.080	.065	1929	.533	.176	.063	.066

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1920–1929, in terms of recovered metals

Year	Mines producing		Ore, old tailings, etc. (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1920	310	8	14,920,478	231,528.65	$4,786,122	5,355,303	$5,837,280
1921	178	37	5,455,030	141,753.41	2,930,303	2,469,394	2,469,394
1922	285	33	10,746,045	170,479.98	3,524,134	4,531,864	4,531,864
1923	317	24	17,015,178	296,109.23	6,121,121	7,343,742	6,021,868
1924	266	9	19,820,505	235,995.74	4,878,465	6,649,276	4,455,015
1925	368	18	20,927,382	201,740.92	4,170,355	7,257,868	5,036,961
1926	362	21	22,382,685	234,010.97	4,837,436	7,381,027	4,605,761
1927	293	15	21,991,874	200,494.59	4,144,591	6,847,680	3,882,635
1928	298	22	22,828,766	191,927.23	3,967,488	6,791,351	3,972,940
1929	390	22	25,860,772	202,318.14	4,182,287	7,543,283	4,020,570

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1920	558,256,302	$102,719,160	14,599,765	$1,167,981	1,457,296	$118,041	$114,628,584
1921	185,034,194	23,869,411	6,541,433	294,364	----------	----------	29,563,472
1922	400,043,128	54,005,822	15,070,894	828,899	210,624	12,006	62,902,725
1923	618,928,602	90,982,504	16,291,548	1,140,408	519,103	35,299	104,301,200
1924	677,752,013	88,785,514	18,642,314	1,491,385	----------	----------	99,610,379
1925	713,355,129	101,296,428	23,876,017	2,077,213	7,332,116	557,241	113,138,198
1926	723,296,051	101,261,447	23,258,274	1,860,662	12,946,423	970,982	113,536,288
1927	682,190,547	89,366,962	19,865,961	1,251,556	2,268,960	145,213	98,790,957
1928	732,276,803	105,447,860	14,380,964	834,096	1,278,636	77,997	114,300,381
1929	830,628,411	146,190,600	16,054,122	1,011,410	2,458,580	162,266	155,569,133

GOLD

In 1929 the production of gold in Arizona increased more than 5 per cent compared with 1928. The largest increase, that in Yavapai County, was due chiefly to the large increase in the output of copper ore from the United Verde and United Verde Extension mines. There was also a large increase in the production of gold in Cochise County, chiefly from the Calumet & Arizona and Shattuck-Denn properties. The largest decrease was in Mohave County and was due to curtailment of operations at the mine and mill of the Katherine Gold Mining Co. There was also a large decrease in gold from Pima County. Large increases in gold production were reported by the United Verde, Calumet & Arizona, Shattuck-Denn, United Verde Extension, Arizona-Eastern, Ibex, Eagle-Picher Lead, and Magma companies; substantial decreases were reported by the Katherine, New Cornelia, Tonopah-Belmont, Morenci branch of the Phelps Dodge Corporation, Bunker Hill, and Night Hawk Leasing companies. The output of gold from the Copper Queen branch of the Phelps Dodge Corporation and from the Ray mines of the Nevada Consolidated Copper Co. was about the same as that in 1928. Of the total output of gold 3.4 per cent was recovered from ore and old tailings treated in gold and silver mills, 24.13 per cent was recovered from ore and old tailings concentrated, and 71.93 per cent was from crude ore shipped for smelting. Ores treated by amalgamation yielded gold valued at $9,113 and ores and old tailings treated by cyanidation $133,047. Concentrates yielded gold valued at $1,009,135 in 1929, compared with $1,036,285 in 1928, and crude ore smelted $3,008,295, compared with $2,624,753 in 1928. The chief gold-producing districts in 1929 were the Verde in Yavapai County, the Warren in Cochise County, the Ajo in Pima County, the Pioneer in Pinal County, the San Francisco in Mohave County, the Globe in Gila County, and the Greenlee in Greenlee County; all except the San Francisco district produced copper ore.

Of the mines producing gold in Arizona in 1929 the United Verde Copper Co. reported the largest output; the Calumet & Arizona near Bisbee was second; and the Copper Queen at Bisbee, the New Cornelia at Ajo, the United Verde Extension at Jerome, the Magma at Superior, the Shattuck-Denn near Bisbee, the Tom Reed at Oatman, the Morenci branch of the Phelps Dodge Corporation, the Old Dominion at Globe, and the Arizona-Eastern near Octave followed.

SILVER

The production of silver in Arizona in 1929 increased 11 per cent, but the value increased only a little more than 1 per cent, as the average price of silver decreased from 58.5 cents an ounce in 1928 to 53.3 cents an ounce in 1929. The silver production of the State was more than 7,000,000 ounces in each of the years 1916, 1923, 1925, and 1926; in 1927 the output declined to 6,847,680 ounces and in 1928 to 6,791,351 ounces. The output in 1929 increased to 7,543,283 ounces and was the largest ever recorded in the State. Good increases in the output of silver were made in Cochise, Yavapai, Santa Cruz, Pinal, and Gila Counties. The largest increase was made by the Calumet & Arizona Mining Co.; good increases were also made by the Magma, Eagle-Picher Lead (Montana mine), Shattuck-Denn, Gold Crown Silver, United Verde Extension, 79 Lead-Copper, and Sheldon companies. Large decreases were reported by the Bunker Hill, Copper Queen branch of the Phelps Dodge Corporation, Commonwealth, New Cornelia, Reymert, United Verde, and Morenci branch of the Phelps Dodge Corporation. Bullion from gold and silver ores contained 14,063 ounces of silver recovered by cyanidation and 3,143 ounces recovered by amalgamation. Concentrates yielded 28 per cent of the total output of silver and crude ore shipped to smelters 71 per cent.

Of the total silver from Arizona in 1929 more than 74 per cent came from the ore of the United Verde, Calumet & Arizona, Magma, Copper Queen branch of the Phelps Dodge Corporation, and United Verde Extension, each of which produced more than 450,000 ounces. Other mines that yielded more than 100,000 ounces of silver each in 1929 were the Shattuck-Denn, Montana (Eagle-Picher Lead), New Cornelia, Morenci branch of the Phelps Dodge Corporation, Gold Crown Silver, and Old Dominion properties.

COPPER

The production of copper in Arizona in 1929 was 830,628,411 pounds, the largest output in the history of metal mining in the State and an increase of nearly 9 per cent over the former record output in 1918—764,855,874 pounds. From 1904 to 1929, inclusive, the State produced 6,313,835 short tons of copper, and in 1929 the output exceeded that of Utah, the State next in order, by more than 512,000,000 pounds. Unusually large increases in copper production were recorded in Yavapai, Gila, and Cochise Counties, but a marked decrease was reported from Pima County. All the large producers of copper in Arizona, except the New Cornelia and the Nevada Consolidated (Ray mines), reported substantial increases. The United Verde and the Inspiration companies increased their output more than 18,000,000 pounds each, and the United Verde Extension, Miami, Copper Queen branch of the Phelps Dodge Corporation, Calumet & Arizona, and Shattuck-Denn companies increased their output more than 7,500,000 pounds each. Of the total copper produced in the State in 1929 50 per cent was obtained from concentrates, 38 per cent from crude ore smelted, nearly 10 per cent from ore leached, and nearly 2 per cent from mine-water precipitates. Of the total output from crude ore smelted Yavapai County yielded 54.9 per cent and Cochise County 37.5 per cent; most of the remainder came from Pinal, Gila, and Greenlee Counties. The copper from ore milled came mainly from Gila, Pinal, Cochise, Pima, Greenlee, and Yavapai Counties. The low-grade disseminated ores in Cochise, Gila, Greenlee, Pima, Pinal, and Yavapai Counties, treated by concentration or leaching, yielded 412,452,720 pounds of copper in 1929, or nearly half the total copper produced in the State.

Ten properties, each yielding more than 39,000,000 pounds, produced 93 per cent of the total copper from Arizona in 1929. The

United Verde was first, followed by the Copper Queen branch of the Phelps Dodge Corporation, Inspiration, New Cornelia, Nevada Consolidated (Ray mines), United Verde Extension, Miami, Morenci branch of the Phelps Dodge Corporation, Calumet & Arizona, and Magma mines. Other mines that produced more than 3,500,000 pounds of copper each were the Old Dominion, Shattuck-Denn, Christmas, Verde Central, and Arizona Commercial.

LEAD

The production of lead in Arizona increased from 14,380,964 pounds in 1928 to 16,054,122 pounds in 1929. The output was slightly less than the average annual output for the decade 1920 to 1929 and considerably less than the record output of 27,062,087 pounds made in 1916. The increase was due chiefly to the large increase in the output of lead from the 79 mine near Hayden Junction, Gila County; this mine again became active late in 1928 and was the largest lead producer in Arizona in 1929. There were also large increases in the output of lead from the Montana mine of the Eagle-Picher Lead Co. near Ruby, Santa Cruz County; from old tailings shipped from the Grand Central dump near Tombstone, Cochise County; and from the Blue Bird property near Mammoth, Pinal County. Unusually large decreases, however, were reported from the Copper Queen branch of the Phelps Dodge Corporation and the Shattuck-Denn mine, both at Bisbee, Cochise County, and from the Belmont-MacNeill mine near Palo Verde, Maricopa County.

Of the total lead produced in Arizona in 1929 nearly 32 per cent was recovered from concentrates and nearly 64 per cent from crude ore smelted; most of the remainder was obtained from old tailings shipped for smelting. Most of the lead produced from ore concentrated came from two mines—one near Ruby, Santa Cruz County, which produced lead-zinc ore, and the other near Palo Verde, Maricopa County, which produced copper-lead ore. More than three-fourths of the lead produced from crude ore smelted came from oxidized lead ore from two mines—one at Bisbee, Cochise County, and the other near Hayden Junction, Gila County.

The largest producers of lead in Arizona in 1929 were the 79, Montana (Eagle-Picher Lead), Copper Queen branch of the Phelps Dodge Corporation, Belmont-MacNeill, Grand Central tailings dump, and Blue Bird mines; these six properties yielded nearly 85 per cent of the total lead output of the State. Considerable lead was also produced from properties near Pantano, Pima County.

ZINC

The production of zinc in Arizona increased from 1,278,636 pounds in 1928 to 2,458,580 pounds in 1929. The average annual output of zinc in Arizona for the decade 1920 to 1929 was 2,847,174 pounds. The increase in 1929 was due chiefly to the activity of the Eagle-Picher Lead Co. at its Montana mine near Ruby, Santa Cruz County. Small quantities of zinc were produced from properties near Chloride, Mohave County, and near Gleeson, Cochise County.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1929, by counties, in terms of recovered metals

County	Gold					Silver (lode and placer)	
	Lode		Placer		Total value		
	Fine ounces	Value	Fine ounces	Value		Fine ounces	Value
Cochise	70, 696. 53	$1, 461, 427			$1, 461, 427	2, 416, 945	$1, 288, 232
Coconino	9. 33	193			193	564	301
Gila	7, 236. 32	149, 588			149, 588	327, 502	174, 558
Graham	9. 77	202			202	7, 548	4, 023
Greenlee	4, 235. 81	87, 562			87, 562	118, 867	63, 356
Maricopa	2, 005. 00	41, 447	7. 74	$160	41, 607	67, 394	35, 921
Mohave	7, 144. 12	147, 682			147, 682	33, 429	17, 818
Pima	15, 001. 47	310, 108	24. 44	505	310, 613	215, 255	114, 731
Pinal	10, 147. 53	209, 768			209, 768	1, 240, 771	661, 331
Santa Cruz	1, 891. 27	39, 096			39, 096	283, 047	150, 864
Yavapai	81, 694. 25	1, 688, 770	224. 17	4, 634	1, 693, 404	2, 810, 859	1, 498, 188
Yuma	1, 973. 31	40, 792	17. 08	353	41, 145	21, 102	11, 247
	202, 044. 71	4, 176, 635	273. 43	5, 652	4, 182, 287	7, 543, 283	4, 020, 570
Total, 1928	191, 617. 63	3, 961, 088	309. 60	6, 400	3, 967, 488	6, 791, 351	3, 972, 940

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Cochise	186, 983, 144	$32, 909, 033	3, 139, 485	$197, 788	47, 120	$3, 110	$35, 859, 590
Coconino	202, 520	35, 644	1, 000	63			36, 201
Gila	196, 789, 955	34, 635, 032	5, 951, 967	374, 974			35, 334, 152
Graham	23, 436	4, 125	247, 925	15, 619			23, 969
Greenlee	57, 094, 667	10, 048, 661					10, 199, 579
Maricopa	264, 453	46, 544	1, 553, 860	97, 893			221, 965
Mohave	24, 926	4, 387	161, 417	10, 169	133, 414	8, 805	188, 861
Pima	73, 861, 331	12, 999, 594	817, 004	51, 471			13, 476, 409
Pinal	105, 817, 156	18, 623, 819	679, 569	42, 813			19, 537, 731
Santa Cruz	1, 057, 700	186, 155	3, 275, 876	206, 380	2, 278, 046	150, 351	732, 846
Yavapai	208, 171, 605	36, 638, 203	153, 613	9, 678			39, 839, 473
Yuma	337, 518	59, 403	72, 406	4, 562			116, 357
	830, 628, 411	146, 190, 600	16, 054, 122	1, 011, 410	2, 458, 580	162, 266	155, 569, 133
Total, 1928	732, 276, 803	105, 447, 860	14, 380, 964	834, 096	1, 278, 636	77, 997	114, 300, 381

Ore, old tailings, etc., sold or treated, lode mines producing, and average value of ore, etc., in gold and silver in Arizona, 1928 and 1929, by counties

County	Ore, old tailings, etc. (short tons)		Lode mines producing		Average value per ton in gold and silver	
	1928	1929	1928	1929	1928	1929
Cochise	2, 436, 595	2, 826, 186	33	41	$1. 06	$0. 97
Coconino	12	1, 270	2	5	5. 75	. 39
Gila	9, 616, 732	11, 439, 598	29	39	. 03	. 03
Graham	995	621	3	5	. 55	6. 81
Greenlee	1, 585, 466	1, 745, 012	4	6	. 13	. 09
Maricopa	22, 301	18, 353	15	15	5. 44	4. 22
Mohave	31, 558	10, 569	40	44	10. 12	15. 66
Pima	3, 688, 350	3, 617, 735	36	59	. 14	. 12
Pinal	3, 520, 671	3, 893, 128	26	40	. 24	. 22
Santa Cruz	32, 885	46, 338	35	38	3. 39	4. 10
Yavapai	1, 890, 830	2, 255, 441	53	66	1. 55	1. 41
Yuma	2, 371	6, 521	22	32	11. 81	7. 98
	22, 828, 766	25, 860, 772	298	390	. 35	. 32

MINING INDUSTRY

During 1929 the mining industry in Arizona enjoyed the most prosperous year since the war period. Increases were recorded in the output of the five principal metals, and new records were established in the output of silver and copper. The total value of the output has been exceeded in only three years—1916, 1917, and 1918. The sum paid in dividends during 1929 was the largest on record. That the large producers of copper in Arizona were in a position to respond immediately to the increased price of copper is shown by the increase of nearly 100,000,000 pounds in output of copper over 1928. Many of the larger companies appropriated large sums of money to be used for plant improvement. More than $3,000,000 was spent at the New Cornelia for new crushing and concentrating equipment and new machinery for the open pit; the Calumet & Arizona Copper Co. spent more than $2,000,000 for improvements at the smelter at Douglas and for new power plants and hoisting equipment for the mines near Bisbee; the Magma Copper Co. and the United Verde Copper Co. allotted $2,000,000 each for shaft-sinking programs extending over a period of three years. The Phelps Dodge Corporation appropriated large sums for improvements at the Douglas and Clifton smelters. In addition to the above there were many smaller expenditures, including the rebuilding of the Humboldt smelter by the Sheldon Mining Co.; the plant was idle in 1929, but the furnaces were again active February 4, 1930. The erection at El Paso, Tex., of a new electrolytic copper refinery by the Nichols Copper Co. will make a decided change in the marketing of copper bullion from Arizona, as the entire product except the electrolytic copper from the two leaching plants has always been shipped east for refining. The new refinery has a capacity of 100,000 tons of electrolytic copper a year and was placed in operation early in 1930. New anode casting plants have been installed at both the Copper Queen and Clifton plants of the Phelps Dodge Corporation and at the Douglas smelter of the Calumet & Arizona Mining Co. The merger of the Calumet & Arizona Mining Co. and the New Cornelia Mining Co. was effected during April, 1929, and resulted in the reorganized Calumet & Arizona Mining Co. with a capitalization of $20,000,000. Detailed articles published in the Engineering and Mining Journal and other periodicals describe the noteworthy developments during the year at the important Arizona properties. Special articles dealing with the methods and costs of mining and milling at various plants were also issued by the mining division of the Bureau of Mines.

ORE CLASSIFICATION

Ore, old tailings, etc., sold or treated in Arizona, 1920–1929, with content in terms of recovered metals

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
DRY AND SILICEOUS ORE						
1920	280,701	149,518.03	1,051,982	505,153	46,123	
1921	233,201	116,457.77	580,349	121,903	56,171	
1922	246,286	108,415.11	1,012,558	291,677	762,602	
1923	556,293	184,458.86	1,968,675	5,567,683	40,870	
1924	239,755	100,630.06	610,213	1,268,955	30,270	
1925	124,990	36,963.83	505,727	251,411	1,131,863	
1926	139,949	50,685.30	460,826	327,205	67,669	
1927	151,701	30,418.12	461,321	229,548	48,898	
1928	146,825	22,583.49	486,842	1,457,928	52,311	
1929	89,904	16,081.99	403,508	1,244,920	64,536	
COPPER ORE						
1920	14,516,580	76,402.41	[1] 3,716,246	[1] 557,364,143		
1921	5,181,177	21,732.17	[1] 1,241,436	[1] 184,812,780		
1922	10,431,729	57,745.04	[1] 2,766,277	[1] 399,264,191	2,812	
1923	16,331,974	106,691.21	[1] 4,269,278	[1] 612,303,029	7,282	
1924	19,460,836	128,121.07	[1] 5,101,837	[1] 675,638,828		
1925	20,634,428	[1] 153,349.54	[1] 5,795,173	[1] 711,380,756	151	
1926	22,031,292	167,920.23	[1] 5,984,415	[1] 720,968,835	244	
1927	21,677,976	159,843.83	[1] 5,702,270	[1] 681,158,850	674	
1928	22,584,270	161,071.48	[1] 5,885,625	[1] 729,992,797	3,383	
1929	25,669,975	[1] 179,488.76	[1] 6,598,986	[1] 828,414,224	337,211	
LEAD ORE						
1920	116,269	5,352.21	521,441	213,346	13,641,815	
1921	40,511	2,947.62	645,563	89,263	6,435,217	
1922	67,138	3,723.28	744,559	461,980	14,119,456	
1923	115,369	4,514.11	1,090,534	1,035,034	15,991,220	
1924	114,670	6,407.26	912,741	725,567	18,373,553	
1925	127,944	7,807.84	803,153	877,474	19,580,573	
1926	157,854	10,686.05	716,945	837,443	19,478,777	
1927	137,195	9,090.83	609,718	609,519	18,408,177	28,518
1928	50,651	3,399.64	263,130	457,708	9,985,203	
1929	46,476	2,787.97	249,575	506,679	10,418,025	
COPPER-LEAD ORE						
1920	5,108	35.07	65,619	173,660	842,037	
1921	141	10.00	1,956	10,248	50,045	
1922	435	16.97	8,357	25,280	101,673	
1923	229	16.74	15,183	22,856	101,119	
1924	5,244	685.50	24,458	118,663	238,491	
1925	24,565	3,264.49	144,567	833,163	626,720	
1926	25,020	2,607.66	145,989	976,026	360,759	
1927	4,449	246.97	38,824	156,938	546,416	
1928	22,083	3,822.74	60,162	291,798	2,833,572	
1929	18,608	1,822.82	62,809	279,081	2,162,116	
ZINC ORE AND LEAD-ZINC ORE [2][3]						
1920	1,820				69,790	1,457,296
1922	457				84,351	210,624
1923	1,313				151,057	519,103
1925	15,455	148.80	9,224	12,325	2,536,710	7,332,116
1926	28,570	1,772.77	72,796	186,542	3,350,825	12,946,423
1927 [2]	20,553	592.16	35,504	35,692	861,796	2,240,442
1928	24,937	740.28	95,546	76,572	1,506,495	1,278,636
1929 [2]	35,809	1,863.17	228,363	183,507	3,072,234	2,458,580

[1] Includes metal recovered from precipitates.

[2] Includes copper-lead-zinc ore as follows: 1927, 7,481 tons, yielding 478.34 ounces of gold, 18,212 ounces of silver, 22,346 pounds of copper, 371,487 pounds of lead, and 767,893 pounds of zinc; 1929, 1,300 tons, yielding 68.20 ounces of gold, 2,782 ounces of silver, 11,457 pounds of copper, 19,100 pounds of lead, and 88,058 pounds of zinc.

[3] No production reported for 1921 and 1924.

Ore, old tailings, etc., sold or treated in Arizona in 1929, with content in terms of recovered metals

Source	Mines producing	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	69	[1]68, 891	14, 428. 87	37, 511	1, 076, 115	20, 136	--------
Dry gold and silver ore	11	9, 377	1, 477. 56	79, 340	38, 084	36, 467	--------
Dry silver ore	30	[2]11, 636	175. 56	286, 657	130, 721	7, 933	--------
Copper ore	198	[3]25, 669, 975	[4]179, 488. 76	[5]6, 598, 986	[6]828, 414, 224	337, 211	--------
Lead ore	92	[7]46, 476	2, 787. 97	249, 575	506, 679	10, 418, 025	--------
Zinc ore	1	88	--------	--------	--------	924	47, 120
Copper-lead ore	21	18, 608	1, 822. 82	62, 809	279, 081	2, 162, 116	--------
Copper-lead-zinc ore	1	1, 300	68. 20	2, 782	11, 457	19, 100	88, 058
Lead-zinc ore	3	34, 421	1, 794. 97	225, 581	172, 050	3, 052, 210	2, 323, 402
Total, lode mines	[8]390	25, 860, 772	[4]202, 044. 71	[5]7, 543, 241	[6]830, 628, 411	16, 054, 122	2, 458, 580
Total, placers	22	--------	273. 43	42	--------	--------	--------
	412	25, 860, 772	[4]202, 318. 14	[5]7, 543, 283	[6]830, 628, 411	16, 054, 122	2, 458, 580
Total, 1928	320	22, 828, 766	191, 927. 23	[9]6, 791, 351	[10]732,276, 803	14, 380, 964	1, 278, 636

[1] Includes 24 tons of mill cleanings sold to a smelter and 80 tons of old tailings cyanided.
[2] Includes 1,053 tons of old tailings sold to a smelter.
[3] Includes 4,335,742 tons of ore leached, 90 tons of old tailings leached, and 2,907 tons of old slag, 679 tons of smelter cleanings, 465 tons of old tailings, and 2 tons of old matte sold to a smelter.
[4] Includes 1. 55 ounces of gold recovered from precipitates.
[5] Includes 307 ounces of silver recovered from precipitates.
[6] Includes 13,233,543 pounds of copper recovered from precipitates.
[7] Includes 270 tons of old slag, 7,947 tons of old tailings, and 18 tons of mill cleanings sold to a smelter and 208 tons of old tailings concentrated.
[8] A mine producing more than one class of ore is counted but once in arriving at total for all classes.
[9] Includes 217 ounces of silver recovered from precipitates.
[10] Includes 11,509,594 pounds of copper recovered from precipitates.

Value of metals from ore, old tailings, etc., sold or treated in Arizona in 1929, by classes of ore

Class	Ore, old tailings, etc. (short tons)	Gold	Silver	Copper	Lead	Zinc	Total
Dry gold ore	68, 891	$298, 271	$19, 993	$189, 396	$1, 269	--------	$508, 929
Dry gold and silver ore	9, 377	30, 544	42, 288	6, 703	2, 298	--------	81, 833
Dry silver ore	11, 636	3, 629	152, 788	23, 007	500	--------	179, 924
Copper ore	25, 669, 975	3, 710, 362	3, 517, 260	145, 800, 903	21, 244	--------	153, 049, 769
Lead ore	46, 476	57, 633	133, 024	89, 176	656, 336	--------	936, 169
Zinc ore	88	--------	--------	--------	58	$3, 110	3, 168
Copper-lead ore	18, 608	37, 681	33, 477	49, 118	136, 213	--------	256, 489
Copper-lead-zinc ore	1, 300	1, 410	1, 483	2, 016	1, 203	5, 812	11, 924
Lead-zinc ore	34, 421	37, 105	120, 235	30, 281	192, 289	153, 344	533, 254
	25, 860, 772	[1]4, 176, 635	[1]4, 020, 548	[1]146, 190, 600	1, 011, 410	162, 266	155, 561, 459
Total, 1928	22, 828, 766	3, 961, 088	[2]3, 972, 913	[2]105, 447, 860	834, 096	77, 997	114, 293, 954

[1] Includes value of 1.55 ounces of gold, 307 ounces of silver, and 13,233,543 pounds of copper recovered from precipitates.
[2] Includes value of 217 ounces of silver and 11,509,594 pounds of copper recovered from precipitates.

GOLD ORE

Gold ore, old tailings, etc., which represented about one-fourth of 1 per cent of the total output of ore, old tailings, etc., were reported from 69 mines in 1929. This material, the production of which increased 32 per cent over that in 1928, yielded on the average $4.33 in gold and 0.54 ounce of silver to the ton, 0.78 per cent of copper, and a little lead, and was valued at $7.39 in metals a ton; most of it—69 per cent—was siliceous ore, containing about 1.46 per cent of copper, used as a flux at copper smelting plants. This apparent marked increase is due to the fact that the output in 1928 was classed as gold and silver ore, whereas that in 1929 carried less silver and was classed as gold ore. Nearly all of this siliceous material came from the Copper Queen branch of the Phelps Dodge Corporation at Bisbee, Cochise County. Yavapai County, with 14 mines producing gold ore and old tailings, ranked second, and Mohave County, with 23 mines, ranked third. There was a decided decrease in the quantity of gold ore treated by cyanidation, formerly so important in Mohave County. The output of gold ore from the Octave mine in Yavapai County increased. The largest producers of gold ore were the Copper Queen branch of the Phelps Dodge Corporation at Bisbee, Cochise County; the Octave mine in Yavapai County; and the Tom Reed mine at Oatman and the Katherine mine in the Union Pass district near Kingman, both in Mohave County.

GOLD AND SILVER ORE

Eleven mines in five counties reported the production of gold and silver ore. This material, the production of which was only one-fifth that in 1928, yielded on the average $3.26 in gold and 8.46 ounces of silver to the ton, and a little copper and lead; it was valued at $8.73 in metals a ton. The apparent decrease in the quantity of gold and silver material in 1929 was due to the fact that much of the material mined in 1929 contained less silver and was therefore classed as gold ore. Most of the gold and silver ore produced in 1929 came from two properties in Cochise County—the Bunker Hill near Tombstone and the Commonwealth near Pearce.

SILVER ORE

A total of 30 mines in nine counties reported the output of silver ore and old tailings. This material, the output of which was less than one-third that in 1928, yielded on the average 31 cents in gold and 24.64 ounces of silver to the ton, and a little copper and lead; it was valued at $15.46 in metals a ton. The Reymert mine near Superior, Pinal County, was the largest producer of silver ore in Arizona in 1929, although the output from the property was considerably less than that in 1928. The silver content of the ore from the Bunker Hill property at Tombstone was lower in 1929 than in 1928, and the output was therefore classified as gold and silver ore; this fact accounts in part for the decrease in output of silver ore in the State. Other fairly large producers of silver ore and old tailings were the Black Diamond and Commonwealth mines near Pearce, Cochise County; the Gold Crown Silver mine near Cleator, Yavapai County; and the James G. Blaine mine near Yuma, Yuma County.

COPPER ORE

Of the copper ore, slag, etc., produced in 1929 at 198 mines in Arizona 21,225,353 tons came from eight low-grade disseminated deposits worked by seven companies, whose mines are near Globe, Christmas, Ray, Ajo, Bisbee, Morenci, and Hillside. The crude copper ore mined and smelted (without concentration) amounted to 3,165,287 tons, nearly 78 per cent of which was sulphide material. The total copper ore, etc., sold or treated in 1929 increased 13.66 per cent; it yielded on the average 14.5 cents in gold and 0.257 ounce of silver to the ton, 1.59 per cent of copper, and a little lead, and was valued at $5.87 in metals a ton, compared with $4.88 in 1928. The largest producers of copper ore were the Inspiration, Miami, Nevada Consolidated (Ray mines), New Cornelia, Copper Queen branch of the Phelps Dodge Corporation, Morenci branch of the Phelps Dodge Corporation, and United Verde properties. The largest producers of copper ore for direct shipment to a smelter were the United Verde, Copper Queen branch of the Phelps Dodge Corporation, Calumet & Arizona, and United Verde Extension mines.

LEAD ORE

The output of lead ore, old tailings, etc., decreased from 50,651 tons in 1928 to 46,476 tons in 1929. In 1929 this material yielded on the average $1.24 in gold and 5.37 ounces of silver to the ton, 11.21 per cent of lead, and 0.545 per cent of copper, and was valued at $20.14 in metals a ton. There was a large decrease in the production of lead ore from the mines near Bisbee, Cochise County, but the greatly increased output of lead ore from the 79 mine near Hayden Junction, Gila County, partly offset these losses. Cochise County, however, was again the largest producer of lead ore, old tailings, etc., chiefly from the Copper Queen branch of the Phelps Dodge Corporation, the Grand Central tailings dump, and the Bunker Hill mine. Gila County ranked second in output of lead ore, because of increased production from the 79 mine. Three mines near Patagonia produced nearly all the output of lead ore from Santa Cruz County, which ranked third; most of the remainder came from Pima and Pinal Counties.

ZINC ORE

In 1929 three cars of oxidized zinc ore were shipped from property near Gleeson, Cochise County, to an eastern zinc plant. The ore contained an average of 0.75 per cent of lead and 33.47 per cent of zinc. No zinc ore was produced in 1928.

COPPER-LEAD ORE

Twenty-one mines in seven counties made the output of 18,608 tons of copper-lead ore, a decrease from 22,083 tons in 1928. In 1929 the ore yielded on the average $2.02 in gold and 3.38 ounces of silver to the ton, 0.75 per cent of copper, and 5.81 per cent of lead, and was valued at $13.78 in metals a ton. Nearly all of the copper-lead ore came from the Belmont-MacNeill property near Palo Verde, Maricopa County, operated by the Tonopah Belmont Development Co.

LEAD-ZINC ORE

The output of lead-zinc ore increased from 24,937 tons in 1928 to 34,421 tons in 1929. This ore, produced by three mines in 1929, yielded on the average $1.08 in gold and 6.55 ounces of silver to the ton, 0.25 per cent of copper, 4.43 per cent of lead, and 3.375 per cent of zinc, and was valued at $15.49 in metals a ton. Nearly all the lead-zinc ore came from the Montana mine near Ruby, Santa Cruz County, owned by the Eagle-Picher Lead Co.

COPPER-LEAD-ZINC ORE

In 1929 one property near Chloride, Mohave County, produced more than 1,000 tons of copper-lead-zinc ore, which yielded about $9.17 in metals a ton. No copper-lead-zinc ore was produced in 1928.

Ore, old tailings, etc., sold or treated in Arizona in 1929, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	48,435	565.00	6,709	1,047,251	----------	----------
Gila	205	184.04	149	4,123	----------	----------
Maricopa	[1] 326	244.97	235	334	----------	----------
Mohave	[2] 8,082	6,873.96	8,267	94	170	----------
Pima	15	65.31	36	21	----------	----------
Pinal	261	73.03	37	34	----------	----------
Santa Cruz	4	3.73	9	----------	----------	----------
Yavapai	[3] 10,643	4,780.09	9,645	21,993	19,966	----------
Yuma	920	1,638.74	12,424	2,265	----------	----------
	68,891	14,428.87	37,511	1,076,115	20,136	----------
Total, 1928	52,089	17,844.40	30,424	25,744	5,093	----------

DRY GOLD AND SILVER ORE

Cochise	9,228	1,395.72	76,182	37,108	35,935	----------
Graham	3	2.59	72	61	32	----------
Mohave	20	35.81	1,400	158	----------	----------
Yavapai	106	43.04	1,666	472	----------	----------
Yuma	20	.40	20	285	500	----------
	9,377	1,477.56	79,340	38,084	36,467	----------
Total, 1928	53,264	1,366.63	42,406	1,250,364	502	----------

DRY SILVER ORE

Cochise	[4] 3,600	56.40	18,488	83,737	1,715	----------
Gila	4	----------	960	37	12	----------
Graham	46	----------	72	1,240	----------	----------
Mohave	369	46.84	12,863	1,147	1,000	----------
Pima	348	5.50	26,240	5,863	3,902	----------
Pinal	5,537	41.39	104,607	28,233	----------	----------
Santa Cruz	105	3.60	3,755	4,355	1,227	----------
Yavapai	927	21.83	112,744	6,109	77	----------
Yuma	700	----------	6,928	----------	----------	----------
	11,636	175.56	286,657	130,721	7,933	----------
Total, 1928	41,472	3,372.46	414,012	181,820	46,716	----------

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[1] Includes 1 ton of mill cleanings sold to a smelter.

[2] Includes 2 tons of mill cleanings sold to a smelter and 40 tons of old tailings cyanided.

[3] Includes 21 tons of mill cleanings sold to a smelter and 40 tons of old tailings cyanided.

[4] Includes 1,053 tons of old tailings sold to a smelter.

Ore, old tailings, etc., sold or treated in Arizona in 1929, by counties, with content in terms of recovered metals—Continued

COPPER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	[5] 2,743,568	[6] 67,079.93	[6] 2,240,217	[6] 185,678,784	315,360	
Coconino	1,270	9.36	564	202,520	1,000	
Gila	[7] 11,423,955	6,304.79	251,946	[6] 196,485,172		
Graham	39	.40	213	3,199	1,469	
Greenlee	1,745,012	4,235.80	118,867	[6] 57,094,667		
Maricopa	924	21.34	28,594	106,119		
Mohave	66	28.73	1,274	[6] 10,671	1,411	
Pima	[8] 3,614,751	14,856.31	173,434	73,798,018	1,227	
Pinal	[9] 3,884,323	[6] 9,938.86	[6] 1,111,960	[6] 105,705,339		
Santa Cruz	[10] 8,536	101.55	8,255	859,265	2,391	
Yavapai	[11] 2,242,914	76,805.54	2,662,611	[6] 208,137,436	14,353	
Yuma	4,617	106.15	1,051	333,034		
	25,669,975	[6] 179,488.76	[6] 6,598,986	[6] 828,414,224	337,211	
Total, 1928	22,584,270	161,071.48	[6] 5,885,625	[6] 729,992,797	3,383	

LEAD ORE

Cochise	[12] 21,267	1,599.46	75,349	136,264	2,785,551	
Gila	15,428	746.50	74,351	300,036	5,951,229	
Graham	533	6.80	7,191	18,936	246,424	
Mohave	[13] 441	20.60	4,941	337	107,337	
Pima	[14] 2,151	57.77	11,896	28,259	717,832	
Pinal	2,113	44.25	6,743	3,543	204,270	
Santa Cruz	[15] 3,471	51.88	45,271	15,369	225,195	
Yavapai	818	32.71	23,223	3,577	113,196	
Yuma	254	228.00	610	358	66,991	
	46,476	2,787.97	249,575	506,679	10,418,025	
Total, 1928	50,651	3,399.64	263,130	457,708	9,985,203	

COPPER-LEAD ORE

Gila	6	1.00	96	587	726	
Maricopa	17,103	1,738.68	38,565	158,000	1,553,860	
Pima	470	16.58	3,640	29,170	94,043	
Pinal	894	50.00	17,424	80,007	475,299	
Santa Cruz	92	5.52	2,078	7,723	27,252	
Yavapai	33	11.04	939	2,018	6,021	
Yuma	10		67	1,576	4,915	
	18,608	1,822.82	62,809	279,081	2,162,116	
Total, 1928	22,083	3,822.74	60,162	291,798	2,833,572	

ZINC ORE, LEAD-ZINC ORE, AND COPPER-LEAD-ZINC ORE[16]

Cochise (zinc) Mohave (copper-lead-zinc) Santa Cruz (lead-zinc)	35,809	1,863.17	228,363	183,507	3,072,234	2,458,580
	35,809	1,863.17	228,363	183,507	3,072,234	2,458,580
Total, 1928	24,937	740.28	95,546	76,572	1,506,495	1,278,636

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[5] Includes 978 tons of old slag sold to a smelter.

[6] Includes metal recovered from precipitates.

[7] Includes 3,213,711 tons of ore leached.

[8] Includes 1,122,031 tons of ore leached and 584 tons of smelter cleanings sold to a smelter.

[9] Includes 979 tons of old slag sold to a smelter.

[10] Includes 465 tons of old tailings sold to a smelter and 90 tons of old tailings leached.

[11] Includes 950 tons of old slag, 95 tons of smelter cleanings, and 2 tons of old matte sold to a smelter.

[12] Includes 90 tons of old slag and 7,947 tons of old tailings sold to a smelter and 208 tons of old tailings concentrated.

[13] Includes 18 tons of mill cleanings sold to a smelter.

[14] Includes 135 tons of old slag sold to a smelter.

[15] Includes 45 tons of old slag sold to a smelter.

[16] No zinc ore or copper-lead-zinc ore produced in 1928.

Zinc products (as marketed from Arizona mines and mills) sold to smelters in 1929

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of ore or concentrates	Recovered zinc
		Short tons	*Pounds*	*Per cent*	*Pounds*
Oxidized zinc ore	Cochise	88	58,900	33.47	47,120
Zinc concentrates	Mohave and Santa Cruz	2,789	2,835,077	50.83	2,411,460
		2,877	2,893,977	50.30	2,458,580
Total, 1928		1,601	1,504,898	47.00	1,278,636

METALLURGIC INDUSTRY

Of the total ore, old tailings, etc., produced in Arizona in 1929, 18,235,758 tons, or 70.51 per cent, were treated by concentration, with subsequent smelting of concentrates; 4,335,832 tons, or 16.77 per cent, were leached, with electrolytic precipitation; 3,279,940 tons, or 12.68 per cent, were shipped to smelters; and 9,242 tons, or 0.036 per cent, were treated by amalgamation or cyanidation, chiefly the latter. The quantity of ore treated by amalgamation or cyanidation has been declining steadily in recent years. The quantity of ore leached increased more than 5 per cent over that in 1928, crude ore shipped to smelters increased 17 per cent, and ore and old tailings concentrated increased nearly 15 per cent.

Nine smelting plants within the State, all but one treating copper material, were active throughout the year, and considerable ore from Arizona was treated at El Paso, Tex. The Humboldt smelter in Yavapai County was reconditioned by the Sheldon Mining Co. in 1929, and smelting of copper material began early in 1930. Large increases in the output of blister copper were reported from all the Arizona smelting plants, particularly from the United Verde Extension smelter at Clemenceau, the Calumet & Arizona and Phelps Dodge plants at Douglas, and the International plant at Miami, each of which reported an increase of more than 7,000,000 pounds of copper bullion. An unusually large increase in the output of electrolytic copper was reported from the Inspiration leaching plant near Miami, but a small decrease was reported from the New Cornelia leaching plant at Ajo. Small increases in lead output were reported from the smelting plant of the American Smelting & Refining Co. at El Paso, Tex., and from the lead plant of the Phelps Dodge Corporation at Douglas, Ariz. New construction work at Arizona smelters during 1929 included: A new sampling and bedding system and a new anode casting plant at the Copper Queen branch of the Phelps Dodge Corporation at Douglas; a new anode casting plant and converter plant at the Calumet & Arizona smelter at Douglas; and a new anode casting plant at the Morenci branch of the Phelps Dodge Corporation at Clifton.

Fifty-three milling plants in Arizona were active in 1929. Thirty-four were concentration plants, of which 8 used gravity machines without flotation equipment, 5 used combined gravity and flotation machines, and 21 used straight flotation. Thirteen mills were equipped for amalgamation, 3 for cyanidation, and 3 for leaching.

Large mills and leaching plants in Arizona active in 1929

Name of company	Location of mill	Method of treatment	Rated capacity of mill	Class of ore treated	Product
			Short tons per day		
Phelps Dodge Corporation (Copper Queen branch).	Warren	Flotation	4,800	Copper	Copper concentrates.
Christmas Copper Co	Christmas	do	400	do	Do.
Inspiration Consolidated Copper Co.	Inspiration	Gravity and flotation.	18,000	do	Do.
Do	do	Leaching	9,000	do	Electrolytic copper.
Miami Copper Co	Miami	Flotation	18,000	do	Copper concentrates.
Old Dominion Copper Co.	Globe	do	1,500	do	Do.
Phelps Dodge Corporation (Morenci branch).	Morenci	Gravity and flotation.	5,500	do	Do.
Tom Reed Gold Mining Co.	Oatman	Cyanidation.	250	Gold	Gold bullion.
Katherine Gold Mining Co.	Katherine	do	250	do	Do.
Calumet & Arizona Mining Co. (New Cornelia mines).	Ajo	Flotation	15,000	Copper	Copper concentrates.
Do	do	Leaching	5,000	do	Electrolytic copper.
Nevada Consolidated Copper Co. (Ray mines).	Hayden	Flotation	12,000	do	Copper concentrates.
Magma Copper Co	Superior	Gravity and flotation.	600	do	Do.
Eagle-Picher Lead Co. (Montana mine).	Ruby	Flotation	300	Lead-zinc	Lead concentrates and zinc concentrates.
United Verde Copper Co.	Clarkdale	do	1,200	Copper	Copper concentrates.
Verde Central Mines (Inc.).	Jerome	do	300	do	Do.
Sheldon Mining Co	Walker	do	175	Copper-lead.	Copper concentrates and lead concentrates.

In 1929 the ore treated by amalgamation amounted to 878 tons; it yielded $10.38 in gold and 3.58 ounces of silver to the ton. Ore treated by cyanidation amounted to 8,284 tons; this ore and 80 tons of old tailings yielded $15.91 in gold and 1.68 ounces of silver to the ton. The total value of the bullion recovered from ore and old tailings was $151,331, compared with $310,071 in 1928. The large decrease in 1929 was due chiefly to curtailment in the output of siliceous gold ore from the Katherine mine in the Union Pass district near Kingman, Mohave County. During 1929 cyanidation mills consumed about 20,000 pounds of sodium and potassium cyanide, an average of 0.975 pound per ounce of gold and silver bullion saved and 2.39 pounds per ton of ore and old tailings treated. Amalgamation mills used about 164 pounds of quicksilver, an average of 0.046 pound per ounce of gold and silver bullion saved and 0.187 pound per ton of ore treated.

Mine production of metals at gold and silver mills in Arizona in 1929, by counties, in terms of recovered metals

County	Ore and old tailings treated		Recovered in bullion			
			Amalgamation		Cyanidation	
	Ore	Old tailings	Gold	Silver	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Cochise	3			2,780		
Gila	23		12.72	3		
Maricopa	181		91.87	25		
Mohave	7,993	40	226.25	282	6,423.65	7,124
Pinal	241		65.03	29		
Yavapai	14	40	32.98	4	8.04	6
Yuma	707		11.98	20	4.48	6,933
	9,162	80	440.83	3,143	6,436.17	14,063
Total, 1928	31,290	1,100	532.95	276	13,889.99	20,103

Much new construction work was done at the concentration plants. At the New Cornelia concentrator three additional mill sections were added, new crushers and screens installed, rod mills lengthened, and many other changes made, increasing the capacity of the milling plant to about 15,000 tons a day. At the Inspiration concentrator additions were made to the crushing plant; the table section was discontinued on January 1, 1930. The capacity of the mill is about 18,000 tons a day. At Miami the Miami Copper Co. erected a new coarse-crushing plant and installed additional ball mills, classifiers, and flotation machines, increasing the capacity of the mill to 18,000 tons a day. The new 300-ton flotation plant of the Verde Central Mines (Inc.) at Jerome was completed in December, 1928, and placed in operation in January, 1929. At the Morenci branch of the Phelps Dodge Corporation new crushers, ball mills, classifiers, and flotation units were installed, increasing the capacity of the mill to 5,500 tons a day. New classification equipment was added to the Old Dominion mill at Globe, increasing its capacity to 1,500 tons a day. The new 400-ton flotation plant of the Christmas Copper Co. at Christmas, Gila County, was completed and placed in operation early in June. The addition of larger ball mills and classifiers at the flotation plant of the Copper Queen branch of the Phelps Dodge Corporation at Warren increased the capacity of the mill to about 4,800 tons a day. New flotation plants were completed at the properties of the Monarch Lead Co. and the Payroll Mines (Inc.), both near Chloride, Mohave County, and additions were made at the mill of the Eagle-Picher Lead Co. near Ruby, Santa Cruz County.

Accurate data giving the original contents of the ores concentrated in Arizona were obtained in 1929 for the first time. This information is presented in the following tables, which also show the class, quantity, and contents of the concentrates made from each class of ore, by methods of concentration, and the metallurgic recoveries obtained by the use of flotation. The Bureau of Mines has issued a report [3] on flotation reagents which gives additional information on this subject. Attention is also called to the special articles on milling plants mentioned in the following review by counties and districts.

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[3] Miller, T. H., and Kidd, R. L., Flotation Reagents, 1929: Rept. of Investigations 3112, Bureau of Mines, 1931, 20 pp.

Arizona ore and old tailings concentrated in 1929, by classes of ore, etc., methods of concentration, and classes of concentrates

Class of material concentrated	Method of concentration	Ore and old tailings concentrated	Gross content of mill feed				
			Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Copper sulphide ore	Flotation	13,642,834	40,979.35	1,013,599	352,185,438		
Copper-lead sulphide ore	do	17,593	2,775.43	62,545	459,338	2,062,782	
Lead sulphide ore	do	5,434	90.93	67,604	20,783	244,060	
Lead-zinc sulphide ore	do	[1] 35,721	2,151.04	262,419	279,179	3,573,754	4,225,628
		13,701,582	45,996.75	1,406,167	352,944,738	5,880,596	4,225,628
Siliceous gold ore	Gravity and flotation	9,186	4,409.28	5,144	27,558	73,488	
Copper sulphide ore	do	4,520,691	13,439.93	1,045,976	155,921,286	19,935	
		4,529,877	17,849.21	1,051,120	155,948,844	93,423	
Siliceous gold, silver ore	Gravity	326	58.81	11,183	60	2,535	
Copper sulphide ore	do	1,278	5.64	6,266	176,283		
Lead sulphide ore and old tailings	do	[2] 2,695	194.64	12,533	4,425	339,574	
		4,299	259.09	29,982	180,768	342,109	
Total		18,235,758	64,105.05	2,487,269	509,074,350	6,316,128	4,225,628

[1] Includes 1,300 tons of copper-lead-zinc ore.

[2] Includes 208 tons of old tailings.

Arizona ore and old tailings concentrated in 1929, by classes of ore, etc., methods of concentration, and classes of concentrates—Continued

Class of material concentrated	Method of concentration	Concentrates produced		Gross content of concentrates				
		Class	Quantity	Gold	Silver	Copper	Lead	Zinc
			Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Copper sulphide ore	Flotation	Copper sulphide	769,926	29,626.71	802,737	299,092,262		
Copper-lead sulphide ore	do	Copper-lead sulphide	2,750	1,759.38	40,538	214,426	1,721,024	
Lead sulphide ore	do	Lead sulphide	581	65.28	53,466	16,401	206,289	
Lead-zinc sulphide ore	do	do	[3] 2,829	1,592.58	191,198	183,357	3,186,505	
		Zinc sulphide	2,789	270.59	37,165	50,302	240,495	2,835,077
			5,618	1,863.17	228,363	233,659	3,427,000	2,835,077
			778,875	33,314.54	1,125,104	299,556,748	5,354,313	2,835,077
Siliceous gold ore	Gravity and flotation	Siliceous gold	[4] 361	3,463.60	4,191	8,577	22,184	
Copper sulphide ore	do	Copper sulphide (table)	79,740	4,438.98	372,995	26,157,026		
		Copper sulphide (flotation)	197,098	7,322.00	599,894	104,970,655		
			276,838	11,760.98	972,889	131,127,681		
		Lead sulphide	30	96.20	1,178	940	15,948	
			276,868	11,857.18	974,067	131,128,621	15,948	
			277,229	15,320.78	978,258	131,137,198	38,132	
Siliceous gold, silver ore	Gravity	Siliceous gold, silver	46	42.25	8,379	35	1,894	
Copper sulphide ore	do	Copper sulphide	364	4.04	4,273	126,593		
Lead sulphide ore and old tailings	do	Lead sulphide	[5] 307	135.29	8,943	2,993	254,380	
			717	181.58	21,595	129,621	256,274	
Total			1,056,821	48,816.90	2,124,957	430,823,567	5,648,719	2,835,077

[3] Includes 69 tons of copper-lead concentrates.

[4] Includes 58 tons of lead concentrates.

[5] Includes 26 tons of lead concentrates from old tailings.

Metallurgic results obtained by flotation of Arizona ores and by concentration of Arizona ores and old tailings in 1929

Material treated	Concentrates produced	Ratio of concentration	Per cent recovered in concentrates				
			Gold	Silver	Copper	Lead	Zinc
Ore by flotation:							
Copper sulphide	Copper sulphide	17.72:1	72.30	79.20	84.92	--------	-------
Copper-lead sulphide	Copper-lead sulphide	6.40:1	63.39	64.81	46.68	83.43	-------
Lead sulphide	Lead sulphide	9.35:1	71.79	79.09	78.92	84.52	-------
Lead-zinc sulphide	do	12.63:1	74.04	72.86	65.68	89.16	-------
	Zinc sulphide	12.81:1	12.58	14.16	18.02	6.73	67.09
Total lead-zinc sulphide	----------------------	6.36:1	86.62	87.02	83.70	95.89	67.09
Total ore by flotation	----------------------	17.59:1	72.43	80.01	84.87	91.05	67.09
Total ore and old tailings by all methods	----------------------	17.26:1	76.15	85.43	84.63	89.43	67.09

Gross metal content of Arizona concentrates produced in 1929, by classes of concentrates

Class of concentrates	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	349	2,202.95	10,982	5,608	1,894	------------
Copper	1,047,128	41,391.73	1,779,899	430,346,536	------------	------------
Lead	3,736	3,142.25	254,176	196,158	3,665,854	------------
Zinc	2,789	270.59	37,165	50,302	240,495	2,835,077
Copper-lead	2,819	1,809.38	42,735	224,963	1,740,476	------------
	1,056,821	48,816.90	2,124,957	430,823,567	5,648,719	2,835,077
Total, 1928	900,172	50,130.29	1,886,318	397,102,758	6,701,140	1,476,298

Mine production of metals from Arizona concentrates in 1929, in terms of recovered metals

BY COUNTIES

	Ore and old tailings to concentrating mills		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	1,447,157	208	220,129	5,147.08	132,827	54,303,480	76,130	----------
Gila	8,111,153	--------	206,523	5,944.62	228,461	125,425,020	----------	----------
Greenlee	1,711,449	--------	115,549	3,793.00	97,535	51,969,396	----------	----------
Maricopa	17,181	--------	2,646	1,738.92	42,657	165,362	1,553,860	----------
Mohave	2,195	--------	372	174.59	17,216	12,570	87,818	133,414
Pima	2,457,041	--------	114,475	14,755.98	158,260	53,239,645	81,119	----------
Pinal	3,843,522	--------	282,369	8,325.04	859,381	97,429,977	39,433	----------
Santa Cruz	37,840	--------	5,887	1,762.82	260,747	210,997	3,172,968	2,278,046
Yavapai	607,902	--------	108,833	7,172.85	327,732	32,241,693	63,016	----------
Yuma	110	--------	38	2.00	141	107	29,006	----------
	18,235,550	208	1,056,821	48,816.90	2,124,957	414,998,247	5,103,350	2,411,460

BY CLASSES OF CONCENTRATES

Dry and siliceous	349	2,202.95	10,982	5,440	1,013	----------
Copper	1,047,128	41,391.73	1,779,899	414,615,081	----------	----------
Lead	3,736	3,142.25	254,176	157,407	3,300,654	----------
Zinc	2,789	270.59	37,165	35,297	202,171	2,411,460
Copper-lead	2,819	1,809.38	42,735	185,022	1,599,512	----------

Of the first-class material smelted copper ore constituted the largest part. The mines of the Verde district, Yavapai County, and those of the Warren district, Cochise County, together produced nearly 93 per cent of the copper ore smelted. Dry and siliceous ore ranked second in quantity and lead ore ranked third.

Gross metal content of Arizona crude ore shipped to smelters in 1929, by classes of ore

Class of ore	Quantity (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	70,073	5,493.73	370,176	1,588,436	50,397	
Copper	3,165,287	137,953.69	4,809,863	340,603,200	370,441	
Lead	30,112	2,015.40	150,494	462,360	10,488,064	
Zinc	88				1,320	58,900
Copper-lead	1,015	63.44	22,271	112,101	653,394	
	3,266,575	145,526.26	5,352,804	342,766,097	11,563,616	58,900
Total, 1928	2,792,369	126,972.43	4,871,856	287,368,847	9,133,218	28,600

Mine production of metals from Arizona crude ore shipped to smelters in 1929, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	1,368,750	64,964.43	2,242,653	119,871,404	2,382,975	47,120
Coconino	1,270	9.36	564	202,520	1,000	
Gila	114,711	1,278.99	99,025	6,962,822	5,951,967	
Graham	621	9.79	7,548	23,436	247,925	
Greenlee	33,563	442.80	21,332	5,031,361		
Maricopa	990	138.10	24,537	99,091		
Mohave	321	184.11	8,476	9,643	70,087	
Pima	37,944	236.99	53,734	2,803,791	704,352	
Pinal	48,386	1,747.75	378,869	8,278,735	640,136	
Santa Cruz	7,898	124.46	19,653	823,310	99,511	
Yavapai	1,646,417	74,434.65	2,482,407	175,510,181	90,597	
Yuma	5,704	1,954.83	14,006	337,411	43,400	
	3,266,575	145,526.26	5,352,804	319,953,705	10,231,950	47,120
Total, 1928	2,792,369	126,972.43	4,871,856	269,088,422	8,133,878	22,880

BY CLASSES OF ORE

Dry and siliceous	70,073	5,493.73	370,176	1,236,784	43,557	
Copper	3,165,287	137,953.69	4,809,863	318,174,479	322,858	
Lead	30,112	2,015.40	150,494	438,208	9,284,825	
Zinc	88				924	47,120
Copper-lead	1,015	63.44	22,271	104,234	579,786	

Miscellaneous material other than ore and old tailings milled and crude ore smelted consisted of 13,365 tons of old tailings, slag, old matte, and plant clean-up shipped for smelting and 4,335,832 tons of ore and old tailings leached; this material yielded 823 ounces of gold, 47,967 ounces of silver, 82,442,916 pounds of copper, and 718,822 pounds of lead. The copper came chiefly from ore leached and the gold, silver, and lead chiefly from old tailings. In addition 1.55 ounces of gold, 307 ounces of silver, and 13,233,543 pounds of copper were recovered from precipitates.

Arizona holds an important position in leaching operations compared with other copper-producing States. Two plants, in Gila and Pima Counties, make fine copper after leaching copper ore in tanks followed by electrolytic deposition. At two other properties, in Cochise and Yavapai Counties, copper precipitates were shipped from heap leaching of copper ores; precipitates were also recovered from copper-bearing mine water. More than 1,100,000 tons of oxidized ore were treated at the leaching plant of the New Cornelia Copper Co. at Ajo, but the output of electrolytic copper at this plant was slightly less than that in 1928. No changes were made in 1929 at the leaching plant at Ajo. At the Inspiration leaching plant near Miami new crushing and classification equipment was installed, and early in 1930 a plant to treat primary slime from the leach ore was under construction.

REVIEW BY COUNTIES AND DISTRICTS

In addition to the references made to the technical press on the following pages, attention is called to a bulletin[4] published by the United States Bureau of Mines in 1930, giving recent data on the mine openings, development, and ventilation of the Morenci, Ray, Inspiration, Miami, Magma, Old Dominion, Copper Queen, Calumet & Arizona, United Verde, and United Verde Extension mines. Attention is also called to the mineral industries bulletin[5] of the Arizona Bureau of Mines.

COCHISE COUNTY

In Cochise County the production of all metals except lead was greater in 1929 than in 1928, and the increase in copper was exceptionally large. The total value of the metals increased $9,548,136, chiefly because of the large increase in the output of copper from mines at Bisbee. There were 41 mines producing, 8 more than in 1928. The value of the copper output increased from $23,365,741 to $32,909,033, gold from $1,306,007 to $1,461,427, silver from $1,271,178 to $1,288,232, and zinc from $1,396 to $3,110; the value of lead decreased from $367,132 to $197,788; and the total value of the five metals increased from $26,311,454 to $35,859,590. The value of the metal output of Cochise County was close to that of Yavapai County, the largest in the State. The yield of each metal is given in the table on page 770. Ore of smelting grade (1,368,750 tons) yielded on the average $17.38 in metals a ton, compared with $15.34 in 1928. Of the ore smelted 1,297,165 tons were classified as copper ore, of which 626,615 tons were estimated to be oxidized ore and 670,550 tons sulphide ore. The lead ore and old tailings (21,267 tons), as well as the lead concentrates, were shipped to El Paso, Tex., and Douglas, Ariz., and yielded 1,599.46 ounces of gold, 75,349 ounces of silver, 136,264 pounds of copper, and 2,785,551 pounds of lead. First-class lead ore amounted to 11,290 tons, and all but 285 tons were oxidized. Copper ore of milling grade yielded 220,000 tons of copper concentrates, all shipped for smelting. The remainder of the output from Cochise County was siliceous ore and old tailings (mostly siliceous gold ore), nearly all shipped for smelting. A small lot of siliceous silver ore was treated by amalgamation. No placer output was reported for 1929.

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[4] McElroy, G. E., Ventilation of the Large Copper Mines of Arizona: Bull. 330, Bureau of Mines, 1930, 145 pp.

[5] Tenney, J. B., Second Report on the Mineral Industries of Arizona: Arizona Bureau of Mines Bull. 129, July 1, 1930, 108 pp.

Benson district.—Several cars of slag from the old lead smelter at Benson were shipped to Douglas for smelting.

California district.—Five lode mines in the California district produced 255 tons of ore, yielding $87 in gold, 725 ounces of silver, 10,358 pounds of copper, and 51,610 pounds of lead, valued in all at $5,547. Most of the output was first-class sulphide lead ore from the Sunset (Doran prospect) property near Paradise, operated under lease by the Phelps Dodge Corporation. No development was done at the property, and the lease was relinquished late in the year. Small lots of sulphide lead ore were also shipped from the Ananias and White Metal claims. The remainder of the district output consisted of copper ore from the Lost Cabin claim and from the property of the Arizona Lead Copper Co., also near Paradise. The Coronado Copper Corporation did about 500 feet of drifting in the Treasury tunnel on the Ainsworth Copper property in Arizona near Rodeo, N. Mex., but no ore was shipped in 1929. The Hilltop property, a large producer of lead from 1924 to 1926, was idle in 1929.

Cochise and Golden Rule districts (*Johnson, Dragoon*).—Five lode mines in the Cochise and Golden Rule districts produced 579 tons of first-class ore, yielding $889 in gold, 1,066 ounces of silver, 66,587 pounds of copper, and 8,774 pounds of lead, valued in all at $13,729, or $23.71 in metals a ton. The output in 1928 was valued at $9,897 and that in 1927 at $15,707. Most of the material mined in 1929 was sulphide copper ore from the Mammoth & Republic property of the Arizona United Development Co. near Dragoon; the ore was shipped to El Paso, Tex., for smelting. The G. S. C. & L. Leasing Co. did about 250 feet of tunnel work at the Golden Rule mine near Manzora and shipped two cars of oxidized lead ore containing considerable gold to the smelter at Douglas. At the Climax mine near Cochise the Johnson Copper Development Co. deepened the shaft 60 feet, did about 350 feet of drifting, and shipped one car of first-class oxidized copper ore. A car of oxidized copper ore was also shipped from the Keystone property near Dragoon.

Dos Cabezas and Teviston districts.—The V. M. P. Leasing Co., operating the Le Roy property of the Le Roy Consolidated Mines Co., 1½ miles east of Dos Cabezas, did about 200 feet of development and produced more than 800 tons of sulphide lead ore, which was treated in a small table concentration mill. The resulting lead concentrates, containing considerable gold, and a little first-class lead ore were shipped to the Copper Queen lead smelter. The output in 1929 was considerably less than that in 1928. No production was reported from the property of the Central Copper Co. near Dos Cabezas, and the 500-ton flotation mill was idle. The company was an important producer of copper from 1926 to 1928, but in 1929 work was confined to 4,200 feet of diamond drilling and 1,600 feet of other development.

Huachuca Mountain district.—The Arid Mines & Development Co. shipped a small test lot of siliceous silver ore from its Wakefield group northeast of Patagonia and did about 500 feet of development. No ore was shipped from the Lucy Bell group of claims near Stark, but the company reported the erection of a new mine plant and more than 1,000 feet of development, chiefly in drifts.

Swisshelm district (*Webb, Elfrida*).—A small lot of oxidized copper ore from a property in the Swisshelm Mountains was shipped to Douglas for smelting. The Four-Horse Mining Co. operated its mine near Elfrida continuously and produced about 100 tons of silver-lead ore, which was stored.

Tombstone district.—Seven lode mines and one old tailings dump in the Tombstone district produced 15,601 tons of ore and old tailings, yielding $34,530 in gold, 99,423 ounces of silver, 86,793 pounds of copper, and 843,817 pounds of lead, valued in all at $155,959, or $10 in metals a ton, a decrease from $177,382 in 1928. The output in 1929 consisted of 6,546 tons of first-class ore and 7,947 tons of old tailings shipped for smelting and 900 tons of ore and 208 tons of old tailings concentrated. The old tailings contained considerable gold, silver, copper, and lead and came from the Grand Central dump near Tombstone, which was under lease. Nearly all the crude ore from the Tombstone district was siliceous gold and silver ore from the Bunker Hill mine at Tombstone. However, several hundred tons of lead ore, also from the Bunker Hill property, was milled locally; the resulting concentrates and several hundred tons of first-class oxidized lead ore were shipped to the smelters at El Paso, Tex., and Douglas, Ariz. The company reported about 800 feet of development in 1929, chiefly in drifts. The Gallagher Vanadium & Rare Minerals Corporation treated about 300 tons of low-grade lead ore from the dump in a 50-ton rod mill equipped with four Deister tables; the resulting lead concentrates were shipped to Douglas for smelting. The chief mineral is vanadinite but the vanadium is lost at a lead smelter; operations ceased in May. Other shipments from the Tombstone district consisted of siliceous silver ore from the dump of the Bob Ingersoll mine, similar material from the Bishop and Solstice claims, a little siliceous gold and silver ore from the Old Guard mine, and a small lot of oxidized lead ore from the Pandora mine.

Turquoise district (*Courtland, Pearce, Gleeson*).—Thirteen lode mines and one old tailings dump in the Turquoise district produced 12,372 tons of first-class ore and old tailings, yielding $12,635 in gold, 50,110 ounces of silver, 687,103 pounds of copper, 149,471 pounds of lead, and 47,120 pounds of zinc, valued in all at $172,801, or $13.97 in metals a ton. With the exception of a small lot of siliceous silver ore treated by amalgamation the entire output was first-class ore and old tailings shipped for smelting. The output from the Commonwealth property, an important producer of gold and silver for more than 30 years, was considerably less than that in 1928 and consisted of nearly 3,000 tons of siliceous gold and silver ore and about 1,000 tons of old tailings (siliceous gold) shipped to a smelter at Douglas. Lessees operating the Black Diamond property, a new producer in the Dragoon Mountains near Pearce, shipped more than 2,300 tons of siliceous silver ore containing nearly 2 per cent of copper to smelters at El Paso, Tex., and Douglas, Ariz. The Costello group near Gleeson was worked by various lessees who shipped about 1,700 tons of oxidized copper ore to Douglas and nearly 100 tons of oxidized zinc ore to an eastern zinc plant. The ore is hauled one-half mile east to Holmes, a station on the Southern Pacific Railroad. The Maid of Sunshine mine, owned by the Calumet & Arizona Mining Co., was worked by lessees who shipped several hundred tons of oxidized copper ore to Douglas for smelting. Lessees also shipped 1,099 tons of oxidized copper ore from the Great Western mine near Courtland. The Leadville group near Courtland, which had been idle since 1925, was worked in 1929 by the Holmes Copper Co. under bond and lease, and nearly 400 tons of oxidized copper ore were shipped to El Paso, Tex. The Thelma mine at Courtland was again active in 1929 after being idle in 1928; 500 tons of sulphide copper ore were marketed. Other producers of copper ore were the Vision Point mine 4½ miles east of Pearce and the King Plomo claim at Courtland. The Mystery mine near Gleeson was worked by a lessee who shipped more than 1,000 tons of first-class oxidized lead ore to smelters at El Paso, Tex., and Douglas, Ariz. The output in 1929 was much greater than that in 1928. About 600 tons of siliceous gold and silver ore containing lead and copper were shipped by the Tejon Co. from the Tom Scott mine near Gleeson, and three cars of oxidized silver-lead ore were shipped from the White Tail group 12 miles southwest of Pearce. A small lot of exceptionally rich siliceous silver ore from the Pronto mine near Pearce was treated by amalgamation, and bullion valued at about $1,500 was shipped to a refinery in California.

Warren district (*Bisbee, Lowell, Warren, Don Luis*).—Six lode mines and one old slag dump in the Warren district produced 2,796,419 tons of ore and old slag, yielding $1,410,350 in gold, 2,264,408 ounces of silver, 186,130,352 pounds of copper, and 2,040,899 pounds of lead, valued in all at $35,504,798. The ore was valued at $11.90 in metals a ton. In 1928 seven lode mines produced 2,395,271 tons of ore, yielding $1,224,409 in gold, 1,916,287 ounces of silver, 161,492,168 pounds of copper, and 5,834,540 pounds of lead, valued in all at $25,938,712, or $10.83 in metals a ton. The increase of nearly 25,000,000 pounds in copper was divided evenly among the Calumet & Arizona, Copper Queen branch of the Phelps Dodge Corporation, and Shattuck-Denn properties. The decrease of nearly 4,000,000 pounds in lead resulted chiefly from curtailment at the Copper Queen branch and Shattuck-Denn properties. The output of the district consisted of 1,350,016 tons of first-class smelting ore, 1,445,425 tons of milling ore which was reduced to 220,000 tons of concentrates, and 978 tons of slag shipped to a smelter. The output included considerable copper and a little gold and silver from mine-water precipitates and from heap leaching.

The Copper Queen branch of the Phelps Dodge Corporation at Bisbee was worked continuously and ranked second as a producer of copper in Arizona in 1929, third as a producer of gold and lead, and fourth as a producer of silver. The output of copper increased nearly 9 per cent, and the output of gold was about the same as that in 1928; the output of silver, however, decreased nearly 10 per cent. The output of lead, relatively unimportant, decreased more than 46 per cent from that in 1928. According to the report of the corporation for 1929 development consisted of 90,974 feet of work, including nearly 13,000 feet of diamond and churn drilling. Most of the crude ore shipped for smelting was mined from the group of claims in the limestone area, but 824,189 tons of low-grade copper ore were mined from Sacramento Hill, 688,444 tons of which were treated at the concentrator near Warren, 65,459 tons were directly smelted, and 70,286 tons were leaching ore. Copper ore, concentrates, and precipitates, as well as custom material, were treated at the company's 2,300-ton copper smelter at Douglas. The copper concentrator treated 1,445,425 tons of ore averaging 2.15 per cent of copper, compared with 1,263,729 tons averaging 2.10 per cent of copper in 1928. The ratio of concentration was changed from 7.93 tons to 1 in 1928 to 6.58 tons to 1 in 1929. The recovery of total copper in concentrates was 91.32 per cent, compared with 91.26 per cent in 1928. The copper smelter at Douglas treated 968,655 tons of ore, concentrates, and matte, which produced 37,384 ounces of gold, 1,474,020 ounces of silver, and 166,790,836 pounds of copper. The 150-ton flotation plant erected in 1927 for the treatment of lead ores was idle in 1929 as a result of curtailment in the output of lead ores by custom shippers. The 200-ton lead blast furnace at Douglas was operated about 10 months and treated 41,222 tons of custom lead ore and concentrates, which produced 10,628 ounces of gold, 2,238,188 ounces of silver, and 12,957,547 pounds of lead, a decrease of about 10 per cent from the 1928 production. An article[6] describing this plant was published in November. Steam-shovel operations in the Sacramento pit were suspended in September, and the ore remaining in the west ore body will be extracted by glory-hole methods. The Sacramento shaft has been reconditioned, and main haulage ways have been established on the 500 and 1,000 levels to serve the ore bodies in that section of Sacramento Hill. An article[7] describing various changes was published in October.

At the concentrator at Warren the 6 by 12 foot ball mills in one section were replaced by 8½ by 12 foot Marcy mills in closed circuit with 16 by 24 foot Dorr classifiers. These changes resulted in finer grinding and greater capacity; the mill now has a maximum capacity of 4,800 tons a day. The milling practice at the Copper Queen concentrator was reviewed in an article[8] published in October.

At the Copper Queen smelting plant at Douglas a new crushing, sampling, and bedding system was under construction late in 1929. The new plant will cost about $750,000 and will be in operation about the middle of 1930. The construction of a new anode casting plant designed to make 700-pound anodes for the new electrolytic copper refinery at El Paso, Tex., was completed; it has a capacity of 9,500,000 pounds of anodes a month. The report continues:

Ore and metals contained in output of Copper Queen mines in 1929

Kind of material	Total (dry weight)	Gold	Silver	Copper	Lead	Manganese
Underground limestone:	*Short tons*	*Ounces*	*Ounces*	*Pounds*	*Pounds*	*Pounds*
Copper ore	460,082	23,131	396,714	42,559,087	----------	----------
Lead ore	15,961	703	27,538	436,917	2,259,967	----------
Manganese ore	2,853	----------	----------	----------	----------	2,325,857
West ore body (including Sacramento Hill)	1,095,612	7,726	150,847	53,107,420	----------	----------
East ore body	473,970	2,589	50,522	18,478,090	----------	----------
Precipitates	9,753	----------	174	13,024,183	----------	----------
Total	2,058,231	34,149	625,795	127,605,697	2,259,967	2,325,857

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[6] Ambler, J. Owen, Phelps Dodge Corporation's New Lead Smelter: Min. Cong. Jour., vol. 15, November, 1929, p. 890.

[7] Nelson, F. W., Block Caving and Glory Hole Mining at the Copper Queen: Eng. and Min. Jour., vol. 128, Oct. 5, 1929, p. 538.

[8] Tully, Charles W., Copper Queen Concentrating Operations: Eng. and Min. Jour., vol. 128, Oct. 12, 1929, p. 583.

The ore reserves of both the Copper Queen branch and Moctezuma Copper Company were increased during the year in spite of the large output from these mines. * * *

The El Paso Refinery of the Nichols Copper Company, in which this Corporation is heavily interested as a stockholder, went into operation towards the close of the year and will be producing electrolytically refined copper in March. Not only will this copper occupy a preferential position as regards price in the Middle West but it is expected that the costs of refining will be materially less than on the Atlantic seaboard. The export market is also available from this location at lower freight rates than when the metal was refined in New York. * * *

The increased demand for copper and the higher prevailing market price allowed the tonnage of ores from the Limestone mines to be increased over the preceding year. The copper content of the smelting ore shipped, however, was slightly less. Mining was prosecuted in the Czar, Holbrook, Gardner, Lowell, and Sacramento divisions, also a small tonnage was mined from the Southwest and Uncle Sam. Lease production was practically doubled over the preceding year. Work in the Czar and Holbrook areas developed more ore than was mined. The Gardner and Lowell divisions produced heavily and the reserves in this part of the property at the end of the year were somewhat lower than at the start. The Sacramento division was by far the heaviest producer and here also the reserves were somewhat reduced although a fair tonnage of ore still remains to be mined. In addition there are one or two favorable areas in the Sacramento division that are still to be prospected. The Warren shaft prospecting program was carried forward vigorously during the year and, while no ore was found, some mineralization was encountered on several levels. The pumping capacity at both the Warren and C. & C. shafts has been increased, bringing the total pumping capacity at these shafts up to over 4,000 gallons per minute.

Shovel operations in the West ore body of Sacramento Hill were continued into the month of September, after which all ore was mined by the glory hole method and hoisted at the Sacramento shaft. * * *

Since steam shovel operations were started and up to the time of discontinuance of shovel operations approximately 15,000,000 solid yards of material have been excavated. In addition to the tonnage mined by shovel, 341,709 tons were mined through the glory holes. Production from the Southeast Extension ore body for the year was the largest obtained to date, 422,616 tons being mined. Most of the stoping operations were conducted on the 850-foot level. Combined porphyry ore production for the year amounted to 1,569,582 tons, averaging 2.28 per cent of copper, with a gross content of 71,585,510 pounds, the largest production of any year to date. * * *

Leaching operations proceeded satisfactorily during the year. No additions were made to the Don Luis plant, but No. 7 dump was equipped for leaching. It produced its first copper in August and the results were satisfactory. At the Don Luis precipitation plant 12.288,871 pounds of gross copper were produced with an apparent recovery of 97.24 per cent. A total of 1,020,543 pounds of copper was recovered during the year at the Holbrook plant with an extraction of 94.71 per cent. * * *

The metal produced from branches and subsidiaries of Phelps Dodge Corporation for the year 1929 was 218,360,613 pounds of copper, 2,071,047 pounds of lead, 1,207,097 ounces of silver, 38,249 ounces of gold, and 2,325,857 pounds of manganese. There were also produced from purchased ores smelted 3,642,750 pounds of copper, 10,687,706 pounds of lead, 2,577,130 ounces of silver, and 12,823 ounces of gold. Dividends paid by the Corporation from all property in 1929 amounted to $5,750,000.

There was a substantial increase in the production of gold, silver, and copper from the properties worked by the Calumet & Arizona Mining Co. at Lowell. This company continued to be the largest producer of silver in the district and in 1929 became the largest producer of gold in the district; its copper output, however, was less than half that of the Copper Queen branch of the Phelps Dodge Corporation. The company ranked second as a producer of gold and silver in Arizona in 1929 and ninth as a producer of copper. The chief output was sulphide copper ore containing gold and silver.

The company also produced oxidized copper ore in 1929 but no lead ore. The copper ore from the various shafts of the property is not milled but is shipped direct to the 3,500-ton smelter at Douglas. The mines produced[9] 597,497 wet tons (578,629 dry tons) of ore from the Junction No. 3 and Cole shafts on company account and by lessees. Of this ore 593,940 wet tons was treated at the company's smelter at Douglas. In addition, 3,557 wet tons of low-grade sulphide copper ore was shipped to other plants. The average grade of the ore shipped to the company's smelter was 5.11 per cent of copper, compared with 5 per cent in 1928. The property is developed extensively, and in 1929 the company did 44,523 feet of drifting, 16,947 feet of raising, 40 feet of winze sinking, and 1,429 feet of diamond drilling.

During 1929 a total of 963,786 dry tons of ore and concentrates, consisting of 563,069 tons of ore from the mines at Lowell, Ariz., 57,678 tons of ore from the Eighty-Five branch at Valedon, N. Mex., 117,151 tons of concentrates and cement copper from the New Cornelia mine at Ajo, Ariz., and 225,888 tons of ore from custom shippers, was smelted at Douglas, Ariz. The output comprised 62,357.81 ounces of gold, 2,002,956 ounces of silver, and 130,486,607 pounds of blister copper, compared with about 56,000 ounces of gold, 1,500,000 ounces of silver, and 122,000,000 pounds of blister copper in 1928.

Dividends amounting to $964,136 were distributed to stockholders, making a total of $67,482,019 paid since the organization of the company in 1903 and before consolidation with the New Cornelia Mines Co. in May, 1929. In addition to the foregoing, the consolidated company paid dividends in June, September, and December, amounting to $6,321,427, making the total disbursement for the year $7,285,563. In 1928 dividends amounting to $4,499,299 were paid. The net income for 1929 was $7,733,603.

The report continues:

> In addition to the above, 94,268 cubic feet of stations were excavated on various levels of the Junction and Campbell shafts. * * *
>
> With the object of completely electrifying all power units of the Bisbee mines, a power plant is now under construction. * * *
>
> In the west-central portion of the Oregon claim, on the 1,700 level, and the southern part of the Baton Rouge claim, on the 1,600 and 1,700 levels, considerable sulphide ore was encountered. * * *
>
> A new ore zone was encountered on the 1,900 and 2,000 levels, in the east-central part of the Comet claim, where development work is now progressing. * * *
>
> Development work continued throughout the year in the Campbell ore zone. Ore was cut on the 1,300 level and important increases in ore area were shown on the 1,500, 1,600, 1,700, 1,900, 2,000 and 2,200 levels. * * *
>
> The oxide ore on the 2,200 level, 150 feet north of the Campbell shaft, developed into an irregular ore body of considerable size. * * *
>
> Encouraging ore deposits were found in widely separated areas in the Cole mine—particularly on the 500 level in the southern part of the Smogler claim and on the 1,200 level in the southwestern part of the Atlas claim, where bodies of high-grade copper-silver ore were recently encountered. * * *
>
> During the past year the head frame and hoist were moved from the Irish Mag shaft and erected at the Saginaw shaft. * * *

An interesting report[10] on the mining methods and costs at the Calumet & Arizona property at Lowell was issued by the Bureau of Mines early in 1930.

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[9] Calumet & Arizona Mining Co. Ann. Rept. for 1929.

[10] Lavender, H. M., Mining Methods at the Campbell Mine of the Calumet & Arizona Mining Co., Warren, Ariz.: Inf. Circ. 6289, Bureau of Mines, April, 1930, 18 pp.

The Shattuck-Denn Mining Corporation operated the Shattuck and Denn mines throughout the year and made a large production of gold, silver, and copper. The output of these three metals was much larger than in 1928, but the output of lead declined from 1,548,363 pounds in 1928 to 28,760 pounds in 1929. Lead production from the Shattuck mine was suspended in March. The company ranked sixth in the production of silver in Arizona in 1929, seventh in gold, and twelfth in copper. The most valuable product of the mines was first-class copper ore shipped for smelting; nearly 83 per cent of it was sulphide material from the Denn mine. The 450-ton flotation plant at Don Luis, formerly used to treat low-grade oxidized lead ore, has been idle since 1927. Lead ore of milling grade was shipped to the Copper Queen lead concentrator in 1928, but none was marketed in 1929. According to the report[11] for 1929 the company produced from both properties 128,690 dry tons of ore, from which 5,915.23 ounces of gold, 249,509 ounces of silver, 12,736,150 pounds of copper, and 28,760 pounds of lead were recovered

The Shattuck mine produced 22,380 dry tons of ore, of which 21,020 tons were oxidized copper ore of smelting grade, 165 tons were oxidized lead ore of smelting grade, and the remainder—1,195 tons—was siliceous gold ore smelted. In addition to this output the Denn mine produced 106,311 tons of first-class sulphide copper ore, which yielded 5,512.94 ounces of gold, 241,391 ounces of silver, and 10,730,051 pounds of copper. The oxidized copper ore of smelting grade from the Shattuck mine yielded 2,003,690 pounds of copper, 32 ounces of silver, and 2.62 ounces of gold; the siliceous gold ore smelted yielded 390.81 ounces of gold and 6,588 ounces of silver; and the oxidized lead ore yielded 8.86 ounces of gold, 1,498 ounces of silver, 2,409 pounds of copper, and 28,760 pounds of lead. The average price received for copper was 18.176 cents a pound; the net operating cost per pound of copper at the Shattuck mine was 20.94 cents and at the Denn mine 10.11 cents. During the last six months of 1929 the average cost per pound of copper at the Denn mine was reduced to 8.92 cents.

The gross income for 1929 was $2,372,270, and the net income, after payment of various items for taxes, interest, mining, development, and refining and marketing of metals, was $554,480. The surplus on December 31, 1929, was $4,034,461.

The Denn shaft is 2,200 feet deep; in 1929 the company did 90 feet of winze sinking, 1,230 feet of raising, and 8,467 feet of drifting at a total cost of $133,025, including station cutting. At the Shattuck mine 3,766 feet of work was done in drifting and raising at a total cost of $29,797. The report of the corporation says:

> The Shattuck mine was operated throughout the year. The entire production came from small ore bodies picked up adjacent to the old stope areas. * * * The developments in progress at present are the 48 crosscut on the 800 level into the Iron Prince and Copper Rock claims; the 600 north crosscut on the 600 level into the Southwest claim; 41 crosscut on the 200 level into the Roy claim. The year's operations show a net loss of $58,915.20 for the Shattuck mine. Of the year's expense, $48,768.36 was State and local taxes and $16,840.29 was insurance and fixed overhead. These items would be practically the same if production were discontinued. It is therefore advisable to continue production at this unit until developments in progress have reached their objectives.

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[11] Shattuck-Denn Mining Corporation Ann. Rept. for 1929.

During the year the stations on the 2,100 and 2,200 levels were completed and footwall laterals driven west 1,250 feet on the 2,100 level and 860 feet on the 2,200 level. At this point connection was made with the 2,200 level of the Calumet & Arizona Mining Company property and all water from the Denn mine is delivered to that company at this level, doing away with all pumping operations at the Denn mine above the 2,200 level. From these footwall laterals crosscuts were driven to delimit the ore body and to prepare it for production. The combined production, development, and stoping, from this area, was 90,048 tons, and from the area above the 2,000 level 19,438 tons, of an average value of 5.52 per cent of copper, 0.054 ounce in gold and 2.52 ounces in silver per ton.

During the latter part of the year we opened up some new ore on the Ophir claim on the 1,800 and 2,000 levels, and in the area east of the Mexican Canyon Fault on the 2,200 level. We are still carrying on the development in these areas, but it has not progressed far enough at this date to enable us to make an accurate or correct estimate of the ore body or ore reserves to be expected.

The Night Hawk Leasing Co. continued to operate its own property as well as the property leased from the Phelps Dodge Corporation south of Bisbee. The output consisted of several thousand tons of sulphide copper ore, the larger part of which was produced from claims owned by the Phelps Dodge Corporation; the production was included in the report of the Copper Queen branch. About 1,300 feet of development was done. A dividend of $10,000 was paid in 1929, making a total of $535,000 paid to date.

Late in 1928 the Wolverine & Arizona Mining Co. acquired the Higgins lease from the Night Hawk Leasing Co., and in 1929 the company operated its own mine and the lease continuously. About 3,600 tons of oxidized copper ore was produced from the Wolverine mine and shipped to Douglas for smelting. The company also shipped considerable sulphide copper ore from the Higgins lease and did more than 1,400 feet of development in both properties. Lessees shipped to the smelter at Douglas nearly 1,000 tons of slag, containing chiefly copper, from an old smelter dump near Bisbee owned by the Phelps Dodge Corporation.

COCONINO COUNTY

The marked increase in the output of metals from Coconino County was due chiefly to the shipments of copper ore from claims of the St. Anthony Copper Co. near Jacobs Lake.

Francis district.—Two mines in the Francis district produced oxidized copper ore of smelting grade. The Coconino Copper Mining Co. shipped one car of ore from the Grand Canyon group 10 miles south of Grand Canyon, and similar material came from the Ruby and Emerald group near Anita.

Pine Springs (Wallapai Indian Reservation) district.—Several cars of oxidized copper ore were shipped from the Laguna group near Valentine by the Wallapai Mining Co. and Pine Springs Copper Co. The ore was hauled 37 miles to Pica, a station on the Atchison, Topeka & Santa Fe Railway.

Pipe Springs district.—A small lot of oxidized copper ore from the Spotted Bull (formerly Copper Queen) mine near Pipe Springs was shipped to Tooele, Utah, for smelting.

Warm Springs district.—The St. Anthony Copper Co. did considerable surface trenching and test-pit work at the Mackin (Kaibab) group and shipped nearly 1,000 tons of oxidized copper ore containing about 8 per cent of copper to Garfield, Utah, for smelting. The ore was trucked 167 miles to Marysvale, Utah, a station on the Denver & Rio Grande Western Railroad. The long haul, together with mining, freight, and smelting charges, made marketing of the ore unprofitable, and shipments were discontinued. It was reported, however, that the company has a large deposit of copper ore that can be readily mined.

GILA COUNTY

Operators of 39 mines in Gila County reported 11,439,598 tons of ore sold or treated in 1929, compared with 9,616,732 tons in 1928. Gold increased from $120,774 to $149,588, silver from 235,954 to 327,502 fine ounces, copper from 162,283,851 to 196,789,955 pounds, and lead from 1,351,800 to 5,951,967 pounds. No zinc was produced in 1928 or 1929. The county ranked third in the State in value of metal output; nearly 24 per cent of the total copper produced and 37 per cent of the total lead produced in the State came from Gila County. The increase in total value of the four metals from $23,706,086 in 1928 to $35,334,152 in 1929 was due almost entirely to the increase of 21 per cent in the output of copper and the higher average price obtained for the metal. Most of the increase in the copper output resulted from the operations of two properties, Inspiration Consolidated and Miami Copper; smaller increases were made by the Christmas Copper and Old Dominion companies. Most of the increase in the output of lead and silver was due to regular shipments of lead-silver ore from the 79 mine near Hayden Junction. Of the total output from the county 11,423,955 tons, or 99.86 per cent, were classified as copper material, of which 8,111,153 tons were concentrated; the resulting concentrates—206,523 tons—yielded 5,944.62 ounces of gold, 228,461 ounces of silver, and 125,425,020 pounds of copper. The larger part of the copper material was treated at concentrating or leaching plants near Miami, but some was treated at smelters at Hayden, Douglas, and Superior, Ariz., and El Paso, Tex. All the lead ore from the county was oxidized material shipped to smelters at Douglas, Ariz., or El Paso, Tex. The remainder of the county output was chiefly siliceous gold ore of smelting grade.

Banner district.—Seven lode mines in the Banner district (Gila County) made a total output of 144,346 tons of ore, yielding $33,072 in gold, 107,499 ounces of silver, 5,039,983 pounds of copper, and 5,876,861 pounds of lead, valued in all at $1,347,648, or $9.34 in metals a ton. The output increased considerably over 1928 when 41,836 tons of ore were produced, yielding $8,263 in gold, 21,058 ounces of silver, 1,799,070 pounds of copper, and 979,975 pounds of lead, valued in all at $336,487, or $8.04 in metals a ton. Most of the copper was produced from the Christmas property and most of the silver and lead from the 79 mine. The largest producer in the district was the Christmas Copper Co. (controlled by the Iron Cap Copper Co.), operating property on the Gila River 6 miles north of Winkelman. A new 400-ton concentrating plant was completed and placed in operation in June, 1929, and the company reported[12] a production of 78,048 tons of ore, containing 1.974 per cent of copper, treated in the new flotation plant. The resulting concentrates, together with 51,056 tons of crude smelting ore containing 2.16 per cent of copper, were shipped to

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[12] Iron Cap Copper Co. Ann. Rept. for 1929.

Hayden for smelting. An article[13] describing the new flotation plant was published in July. The Iron Cap Copper Co. reported the production of 4,417,770 pounds of copper, 17,799 ounces of silver, and 486 ounces of gold from the Christmas mine; the copper was sold at an average price of 17.85 cents a pound. The property is opened by drifts and crosscuts from an 830-foot shaft; 8,405 feet of development was done during 1929. The report continues:

> At the property at Christmas, Ariz., construction of a 400-ton concentrating mill and 1,350 hp. Diesel power plant was completed in June. * * * The ore occurs in flat-lying beds and carries about 2 per cent copper. The lowest possible treatment and handling costs were necessary, and it has been no small undertaking to build the plant, to get the mine in condition to deliver the larger tonnage, to rehabilitate the old buildings and construct new in order to house and provide facilities for a town of 800 people. * * *
>
> The net profit for the second half of the year exceeded $100,000. * * *
>
> Practically all of the ore extracted has come from above the 400 level on the west side of the Christmas fault, in a vertical thickness of about 200 feet. * * *
>
> The outstanding development in the mine was the finding of excellent ore on the 800 level after unwatering the shaft to that point. * * *
>
> The ore to supply the mill has been taken out through a tunnel at the 400 level. In order to attack economically the deeper ore, other plans had to be made. The present operating shaft is too small to handle the tonnage and is located near the extreme west end of the ore. * * * A shaft on the east side of the fault, near the mill, has been started. Its cost, including equipment, will be approximately $125,000.

The 79 mine, 4 miles north of Hayden Junction, was operated by lessees during the first three months of 1929, but after April 1 the 79 Lead-Copper Co. became the owner and operator. The total production for 1929 amounted to nearly 15,000 tons of oxidized lead ore containing about 0.05 ounce of gold and 5 ounces of silver to the ton, 1 per cent of copper, and 22 per cent of lead. The property is opened by an inclined shaft 450 feet deep; during 1929 a total of nearly 3,000 feet of development was done, comprising 180 feet of shaft sinking, 712 feet of raises, and about 2,100 feet of drifts and crosscuts. The entire ore output was shipped to Douglas for smelting. The property became the largest producer of lead in Arizona in 1929 and ranked thirteenth as a producer of silver. The remainder of the district output consisted of several hundred tons of oxidized lead ore produced from the Apex mine by the Parnall Gold Mines Corporation, three cars of siliceous gold ore from the Columbia group, and similar ore from the Oro Verde mine and from two prospects near Winkelman.

Globe district (*Miami, Inspiration*).—In 1929, 23 mines in the Globe district made a total output of 11,293,656 tons of ore, yielding $116,106 in gold, 219,646 ounces of silver, 191,596,337 pounds of copper, and 73,061 pounds of lead, valued in all at $33,958,735, or $3.01 in metals a ton. Most of the ore (8,031,905 tons) was concentrated and yielded 201,975 tons of concentrates, which, with 48,040 tons of crude ore, were shipped for smelting. Nearly all the copper concentrates and first-class copper ore went to a smelting plant in the district, but all the lead ore was shipped to El Paso, Tex., or to Douglas, Ariz.

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[13] McDermid, A. J., Christmas Copper Starts Operations at New 400-Ton Concentrator. Eng. and Min. Jour., vol. 128, July 27, 1929, p. 148.

The largest output in the district was from the Inspiration mine, which produced 5,799,587 tons of copper ore. The Miami Copper Co. followed, with 5,017,983 tons. The Old Dominion and Arizona Commercial mines also produced considerable copper ore.

From the Inspiration property[14] a total of 107,307,067 pounds of copper was produced during 1929, consisting of 42,953,405 pounds from concentrating operations, 64,349,914 pounds from leaching, and 3,748 pounds from direct smelting. Compared with 1928 the output of copper increased 19,183,756 pounds. As a result of the increase, especially from leaching operations, the property ranked third as a producer of copper in Arizona in 1929. The ore mined and treated averaged 1.155 per cent of copper; the concentrating and smelting ores averaged 1.114 per cent of copper, and the leaching ores averaged 1.188 per cent of copper. The copper produced in 1929 was recovered from the treatment of 5,773,858 tons of ore, including 457,468 tons of Inspiration concentrating ore, 1,942,182 tons of Live Oak concentrating ore, 117,723 tons of Keystone concentrating ore, 42,529 tons of Southwestern Miami concentrating ore, 245 tons of Live Oak ore of smelting grade, and 3,213,711 tons of leaching ore and slimes.

The smelter assay of the total concentrates produced was 35.667 per cent of copper; flotation concentrates averaged 39.24 per cent, and table concentrates 4.46 per cent. The ratio of concentration was 41.26 to 1. The recovery of total copper in the concentrates, calculated from assays and weights of ore and tailings, was 78.28 per cent, and the recovery of copper sulphides was 95.06 per cent. The cost of fine copper produced, including depreciation but excluding depletion and Federal taxes, amounted to 11.1328 cents a pound. Dividends paid during 1929 amounted to $4,432,376. A dividend of $1,181,967 was paid January 6, 1930, making a total of $51,394,354 paid to date. During 1929, 135,890 feet of development was done, comprising 7,885 cubic yards of excavations, 7,988 feet of diamond drilling, 400 feet of churn drilling, and 439 feet of shaft sinking, making a total of 151.36 miles of workings in the property. The mine and the 18,000-ton concentration-flotation plant, as well as the leaching plant which has a daily capacity of 9,000 tons, were operated the entire year. Operation of the table division of the concentrator, however, was discontinued on December 31, 1929, and the mill will be operated as a straight flotation plant in 1930. Changes in the leaching practice included the installation of large Dorr classifiers in the crushing division. The sands from these machines go to the regular leaching vats as in the original practice, but the primary slime is removed as a classifier overflow and treated in a separate circuit. The slime treatment includes flotation to recover sulphide minerals, followed by agitation leaching of the flotation tailings. The slime leaching plant was under construction in 1929 and started operating in 1930, the slime being stored during most of 1929. The removal of primary slime from the regular leaching vats greatly improved solution percolation, and the leaching extraction of copper increased from 80.373 per cent in 1929 to 89.117 per cent in 1930. Additional data on the old and new methods of leaching mixed ore at Inspiration were published[15] in October.

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[14] Inspiration Consolidated Copper Co. Ann. Rept. for 1929.

[15] Aldrich, Harold W., and Scott, Walter G., Leaching Mixed Oxide and Sulphide Copper at Inspiration: Eng. and Min. Jour., vol. 128, Oct. 19, 1929, p. 612; Slime Treatment and Electrolytic Precipitation at Inspiration: Eng. and Min. Jour., vol. 128, Oct. 26, 1929, p. 652.

A report[16] describing in detail the mining methods employed by this company was published in September. The net income for the year ended December 31, 1929, was $4,753,802; the surplus, after deducting dividends paid in 1929 and one paid early in 1930, was $9,726,080. The report continues:

> By removal of the minus 200-mesh material from ores delivered to the leaching plant, there was a material increase in the percentage recovery of copper from ores leached. The minus 200-mesh material is treated by flotation concentration for recovery of its sulphide copper content, then stored for ultimate treatment in the slimes leaching plant now under construction. * * *
>
> During the year the sinking of an inclined shaft to the 6th level was started at the Live Oak section for the purpose of handling men and supplies and for ventilation, when mining in the territory south of the present stoping areas above this level. * * *
>
> During the year development of Southwestern Miami section was started as an extension of the 1,200 level of the Live Oak division. The haulage drifting necessary for mining the west section of the ore body was completed and production commenced in January, 1930. * * *
>
> The concentrator operated 353 days during the year with an average of 7.667 sections in operation.
>
> The total copper content of the concentrating ore was lower and the oxide copper content higher than in 1928. The percentage recovery of sulphide copper was higher than in the preceding year. * * *
>
> During the year a total of 3,052,268 dry tons of ore were delivered to the leaching tanks. This tonnage represents 350 leaching charges averaging 8,720.9 dry tons per charge. * * *
>
> From all but 14 of the 350 charges the primary slimes were removed by wet classification. The leaching extraction of 89.117 per cent compares with an extraction of 80.373 per cent in 1928. The slimes removed were diverted to the concentrator for flotation treatment, after which they were stored for future treatment in the slimes leaching plant now under construction.
>
> Experimental work in the electrolytic plant indicated that by decreasing the spacing of electrodes from 4½ inches to 4 inches the production of electrolytic copper could be increased 20 per cent. This change is being made. * * *
>
> Construction of a plant to treat the primary slimes removed from leaching ores was started and is expected to be in operation in May, 1930.
>
> During the year your company purchased the property of the Southwestern Miami Development Co., consisting of 212 acres. This property adjoins the southerly boundaries of the Live Oak and Porphyry group of claims. * * *

According to the annual printed report of the Miami Copper Co. 58,841,159 pounds of refined copper were produced from 5,017,983 tons of milling ore at a cost of 11.741 cents a pound. This output was more than 10,500,000 pounds greater than that in 1928, and the property ranked seventh as a producer of copper in Arizona in 1929. New construction work at the copper concentrator was completed in October, and during the last three months of the year the plant operated on a basis of 17,000 tons a day. The concentrator operated 357 days and treated an average of 14,056 tons of ore a day for the entire year, attaining a maximum of 16,990 tons a day during November. The ore treated contained on the average 0.830 per cent of copper, of which 0.685 per cent was sulphide, compared with 0.657 per cent in 1928. The property has in reserve 90,391,980 tons of sulphide ore, averaging 0.88 per cent of copper, and 7,000,000 tons of mixed ore, averaging 1.83 per cent of copper. Development in 1929 consisted of 63,838 feet of drifts, 32,410 feet of raises, and 120 feet of shaft sinking. In addition to work charged to development 34,905 feet of drifts and raises were done on stoping account, or a total of 131,360 feet. From 5,017,983 tons of ore milled 83,691 tons of concentrates were produced, averaging 36.241 per cent of copper, or a recovery of 72.80 per cent. The ratio of concentration was 60 tons to 1. Dividends amounting to $2,614,906 were paid to stockholders in 1929, making a total of $35,558,223 paid since May 15, 1912. The profit for 1929 was $4,151,081, and the surplus after dividends were paid was $10,844,490. The report continues:

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[16] Stoddard, Alfred C., Mining Practice and Methods at Inspiration Consolidated Copper Co., Inspiration, Ariz.: Inf. Circ. 6169, Bureau of Mines, September, 1929, 23 pp.

> During the year ten new stopes were undercut and made ready for production and four stopes were completed with results as to extraction and cost approximately the same as those reported in previous years. To date, thirteen stopes, estimated to contain 11,038,070 tons, have been completely mined. * * *
>
> The cost of mining was $0.01641 higher than for the previous year and is also slightly higher than the average cost of mining the low-grade ore body to date, in part due to the fact that over 12 per cent more ore was undercut during the year than was drawn and the additional reason that the average wages were 15 per cent higher during 1929 than during the previous five years.
>
> The grade of the ore was slightly higher than for the previous year and as the cost per ton of ore to copper in concentrate was reduced from $0.95388 to $0.93439 for the present year, a substantial reduction in the cost per pound of copper in concentrate was made from $0.08421 to $0.07968. * * *
>
> The cost of mining was $0.42308 per ton of ore, the chief items being development, stoping, and electric haulage. * * *
>
> Reference was made in last year's report to a complete remodeling and enlargement program for the mill which had just been started. This work was sufficiently along by September to put the plant on an increased tonnage basis of 17,000 tons per day October 1 and operations during the last three months of the year have been approximately on this basis. At the same time new high steam pressure installations in the power plant reduced the cost of power 40 per cent and this, combined with increased tonnage and more efficient equipment in the mill, resulted in reducing the milling costs for the last three months to 32 cents per ton compared with 36 cents for the year 1929 and 38 cents for the year 1928. Completion of the remodeling of the mill and crusher plant is in progress as operations permit.
>
> The cost per ton of ore of producing refined copper up to concentrate on board cars at Miami was $0.42308 for mining, $0.35913 for milling, and $0.15218 for general expenses, or a total of $0.93439. * * *
>
> New construction during the year amounted to $2,316,605. This is the largest expenditure for this purpose since the property was originally equipped and was expended at this time to enlarge the scale of operations in all departments from 12,000 to 17,000 tons per day. * * *
>
> Improvements at the concentrator, which cost $1,007,726, included two coarse crushers and one large roll, six 8-foot by 10-foot ball mills, six 28-foot bowl classifiers, six 100-foot and six 15-foot flotation cells, and additions to conveyor and ore weighing and feeding equipment. * * *

The Old Dominion Co. at Globe operated its mine and 1,500-ton flotation plant the entire year and shipped copper ore and concentrates to the International smelting plant at Miami. According to the annual report of the company for 1929, a total of 415,891 dry tons of smelting and concentrating ore was mined, averaging 2.65 per cent of copper. The refined copper produced from this ore was 18,943,000 pounds, compared with 17,717,267 pounds in 1928. The concentrates averaged 18.97 per cent of copper, and the ratio of concentration was 8.10 tons to 1. The company ranked tenth as a producer of gold in Arizona in 1929 and eleventh as a producer of silver and copper. Dividends amounting to $14,405,260 were paid to stockholders from December 15, 1905, to December 31, 1918, but no disbursements were made in 1929. The total income for the year was $2,064,105; the expenses, including depreciation, amounted to

$1,814,698; and the net income was $249,407 before depletion. The surplus on December 31, 1929, after deducting depletion, was $1,250,219. The property has been opened to a depth of 2,700 feet; 32,758 feet of development was done in 1929. The ore consists chiefly of the sulphide copper minerals chalcopyrite, bornite, chalcocite, and pyrite; in this respect it differs from the ore at the Inspiration and Miami properties, which is predominantly chalcocite. A detailed report[17] on the mining methods employed at the Old Dominion mine was issued early in 1930.

The following paragraphs are taken from the annual report of the company:

> In view of the limited life of the present known ore reserves such profits as may be derived from operations should be conserved so as to be available for exploration and development until such time as the ore reserves indicate an assured life over a period of a number of years. * * *
>
> Concentrating ores mined during the year came largely from the 1,600 to the 2,200 levels at the East side of the mine, from the large new ore body on the 2,200 and 2,400 levels West and from the Maggie vein. Smelting ores came from the lower levels at the West side. * * *
>
> The results of development were more favorable than for several years, and for the first time since 1924 the amount of new ore developed exceeded the amount of ore mined. New ore found was all of low grade and, as a result, the average grade of the estimated reserves decreased from 2.99 per cent to 2.37 per cent of copper.
>
> It is gratifying to state that development on the 23rd and 24th levels has disclosed a large body of concentrating ore which has materially increased the reserves of the company, both in tonnage and copper contents. * * *
>
> The increase in the reserve tonnage for the year amounted to 483,948 tons of new ore, in addition to which there has been included 179,246 tons of material that had not been considered available before. * * *

The Arizona Commercial Mining Co. worked its mine the entire year on a 1-shift basis and shipped crude smelting ore to Miami and sulphide copper ore to the Old Dominion flotation plant; the resulting copper concentrates were shipped with the Old Dominion product to Miami for smelting. According to the annual printed report of the company the total output of milling ore amounted to 53,327 tons averaging 3.74 per cent of copper and 8,758 tons of siliceous smelting ore averaging 2.50 per cent of copper. The crude smelting ore and milling ore contained 4,428,929 pounds of copper, 29,559 ounces of silver, and 762 ounces of gold, and the company was paid for 3,800,456 pounds of copper, 21,010 ounces of silver, and 596 ounces of gold. The sales of refined copper amounted to 2,631,948 pounds, which sold for an average price of 17.93 cents a pound. Expenditures for mining, treatment, and refining were $332,477; selling, general, and administration costs were $23,136; and depreciation was $21,927. The total dividends paid since October 31, 1916, including $132,500 paid in 1929, amounted to $2,477,750. The total income for 1929 was $538,944; after $377,541 was deducted for expenses the income before depletion was $161,403, and the surplus at the end of the year was $810,180. Development in 1929 consisted of 1,400 feet of drifting and raising and 2,100 feet of diamond drilling. The report continues:

> Practically all of the development work accomplished in 1929 was in the nature of work tending to facilitate the extraction of known ore. No real prospecting by drifting, raising, or sinking was done because there are no likely areas in the mine remaining to be developed above the 2,200 or bottom level. * * *

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[17] Shoemaker, A. H., Mining Methods at the Old Dominion Mine, Globe, Ariz.: Inf. Circ. 6237, Bureau of Mines, February, 1930, 21 pp.

> Results of diamond drilling have been negligible and the work has been abandoned. A considerable quantity of 1¼ per cent heavy sulphide was indicated, but, partly due to unusually difficult drilling conditions, no definite grade or tonnage of ore or near ore can be calculated. * * *
>
> Although the picture of prospecting below the 2,200 level is not bright, the drilling indicates that the next 400 feet in depth is a more favorable horizon for ore than was the last 400 feet, speaking, of course, of the country east of the fault. All of our mine will be east of the Budget fault below the 2,500 level.
>
> The unattractiveness of the country below the 2,200 naturally turned our thoughts and energy to a search for another property of merit. During the year twelve properties, all in the prospect stage, were investigated. * * *
>
> The quantity of ore remaining in the mine running over 3 per cent is practically negligible, but there are probably 25,000 or 30,000 tons of 2½ per cent material still in the mine. * * *

The remainder of the output of ore from the Globe district consisted of about 14,000 tons of copper ore (mostly oxidized) from 15 properties and a few cars of oxidized lead ore, copper-lead ore, and siliceous ore. The Porphyry Reserve Copper Co., operating a group of 67 claims 3 miles west of Burch, did more than 2,500 feet of development and shipped 900 tons of oxidized ore containing about 4.6 per cent of copper. The Van Dyke Copper Co. did nearly 3,000 feet of development and shipped several thousand tons of oxidized copper ore of smelting grade. The property is near Miami and is opened by a 1,600-foot vertical shaft. Lessees operating the Iron Cap property of the Iron Cap Copper Co. near Globe shipped two cars of oxidized copper ore, and the International Smelting Co. shipped from the dump a large quantity of siliceous fluxing material, not considered ore. The Iron Cap Copper Co. paid a dividend of $18,616 in 1929, chiefly from earnings of the Christmas Copper Co. The company report continues:

> The mining property near Globe remains closed. * * * There have been no developments at depth in adjoining properties indicative of conditions below the unfavorable diabase sill encountered in the lower levels of the Iron Cap mine. Late in the year some ore of profitable grade was taken from surface workings on the Bird vein by miners operating under a lease from the company, yielding the company a small royalty. That work continues but has not gone far enough to develop ore of importance.
>
> A large part of the machinery and equipment has either been moved to the Christmas property or sold. * * *

The Carlota Copper Corporation operated the Brewery property 10 miles west of Miami on Pinto Creek and shipped 4,904 tons of oxidized ore containing about 4.8 per cent of copper. More than 1,200 feet of development were done at the property during 1929. The Pinto Valley Co. operated its group of nine claims west of Miami and shipped nearly 700 tons of oxidized copper ore to the Magma smelter at Superior. More than 14,000 feet of drilling have been done at the property, of which 1,080 feet were done during 1929. The Highline mine near Globe was operated by lessees who shipped more than 2,000 tons of oxidized copper ore to the smelter at Miami; the Continental mine 8 miles west of Miami on Pinto Creek, owned by the Old Dominion Co., was also worked by lessees who shipped several hundred tons of oxidized ore containing about 6 per cent of copper. Several thousand tons of low-grade copper ore were shipped to the smelter at Miami from dumps of the Inspiration Consolidated Copper Co. Shipments of copper ore were also made from the Homestake & Gold Dust, Rosaline, Copper Wedge, Schulze, and Stone properties. Lessees worked the Mallory group of the New

Dominion Copper Mining Co. and shipped two cars of first-class oxidized lead ore to the smelter at Douglas. Small lots of similar ore were also shipped from the Defiance and Five & Ten Cents claims. A small lot of copper-lead ore was shipped from the Old Red property near Globe, siliceous silver ore from the Silver Lake mine, and siliceous gold ore from the Wright prospect.

Green Valley district.—The output from five mines in the Green Valley district consisted of a little siliceous gold ore from the Artic and Gold Bond properties treated by amalgamation, a little oxidized lead ore from the Arizona Verde group, and a little oxidized copper ore from the Oxbow and Blue Bell mines near Payson.

Pioneer district.—No output was reported from the Pioneer district in 1929; the old Bobtail property was reopened by the Western Syndicate (Inc.), and considerable retimbering and new drifting were done.

Summit district.—Four lode mines in the Summit district produced 1,552 tons of ore, yielding $85 in gold, 304 ounces of silver, and 150,792 pounds of copper, valued in all at $26,787, or $17.26 in metals a ton. Most of the output was copper ore mined by lessees from the Gibson group of the Bellevue Copper Co., 6 miles south of Miami. The ore was treated in a small table-concentration plant, and the concentrates were shipped to Superior for smelting. Two cars of first-class oxidized copper ore were also marketed from the property. Several cars of similar material were shipped from the Penn and Leach claims. The remainder of the district output consisted of small lots of copper ore from two prospects southwest of Miami.

Young (*Spring Creek*) *district.*—No ore was marketed from the Young district in 1929; the Spring Creek Mining Co., operating the Spring Creek mine near Young, did considerable development in opening up the property.

GRAHAM COUNTY

Five lode mines in Graham County produced 621 tons of ore, yielding metals valued at $23,969, an increase from $15,150 in 1928. Most of the output was first-class oxidized lead ore from the Grand Reef mine 3 miles north of Klondyke.

Aravaipa district.—Four lode mines in the Aravaipa district produced 575 tons of ore, yielding $202 in gold, 7,476 ounces of silver, 22,196 pounds of copper, and 247,925 pounds of lead, valued in all at $23,713, or $41.24 in metals a ton. Most of the output was oxidized lead ore from the Grand Reef mine 3 miles north of Klondyke; several hundred tons of lead ore and one car of oxidized copper ore were shipped to El Paso, Tex., for smelting. A test lot of siliceous gold and silver ore was marketed from the Silver Coin property 3 miles east of Klondyke. The remainder of the district output consisted of oxidized lead ore from the Bullis-Landsman group and from a small prospect, both near Klondyke. The Aravaipa Mining Corporation, an important producer of lead from the Tolman Babcock property in 1926 and 1927, was idle in 1929.

Lone Star district.—A car of low-grade siliceous silver ore containing about 1 per cent of copper was shipped from the Lone Star group 10 miles northeast of Safford to Douglas for smelting.

GREENLEE COUNTY

The total value of the metal output in Greenlee County increased from $7,986,651 in 1928 to $10,199,579 in 1929. The output was chiefly copper ore from the Morenci property of the Phelps Dodge Corporation. The output of copper increased 3,040,505 pounds, but the output of gold and silver decreased; no lead was produced from the county in 1928 or 1929.

Copper Mountain and Greenlee districts (Morenci, Metcalf, Clifton).—The output of the Copper Mountain and Greenlee districts was chiefly copper ore from the Morenci property of the Phelps Dodge Corporation. The company operated its mine and the combined gravity and flotation plant at Morenci and its smelter at Clifton continuously. The concentrator treated 1,711,449 tons of ore, which yielded 115,331 tons of copper concentrates. The Clifton smelter treated a total of 143,604 tons of copper material (including the above concentrates), which yielded 3,664 ounces of gold, 93,094 ounces of silver, and 55,073,615 pounds of copper (37,410,783 pounds as anodes, 8,741,718 pounds as ingots, and 8,921,114 pounds as blister copper). The output of copper in 1929 was nearly 2 per cent greater than that in 1928 and the property ranked eighth in the production of copper in Arizona in 1929 and ninth in gold and silver. More ore was treated in 1929 than in 1928, but its copper content decreased. Of the total ore mined (1,738,084 tons) nearly 2 per cent was shipped to a smelter.

More than 39,000 feet of exploration and development was done at the mine during 1929, including 11,031 feet of work in the lower haulage system and 1,223 feet of drifting in the Longfellow tunnel. The diamond-drilling campaign in the Clay ore body, completed during 1929, indicated a deposit of more than 200,000,000 tons of ore averaging 1.12 per cent of copper. Present plans suggest that production from this zone may begin in 1934. A detailed article[18] describing the mining methods employed at Morenci was published in March.

Articles[19] describing the early history of the Morenci district, the Morenci mine, the Morenci concentrator, and the Clifton smelter were published in June.

The effectiveness of the safety work being done at this property resulted in the awarding of both the James Douglas Memorial safety trophy and the Corporation Severity trophy to the Morenci branch. An excellent description of this work was published[20] in 1930.

Changes made in the Morenci concentrator during 1929 included the addition of two 7-foot Symons cone crushers, three 8½ by 12 foot ball mills, additional classifiers, and additional Diesel-engine power equipment. These changes increased the capacity of the combined table and flotation plant from 4,500 tons to about 5,500 tons of ore a day. The article on the Morenci mill, cited in footnote 19, gives additional data on the development and present practice at the concentrator.

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[18] Mosier, McHenry, and Sherman, Gerald, Mining Practice at Morenci Branch, Phelps Dodge Corporation, Morenci, Ariz.: Inf. Circ. 6107, Bureau of Mines, March, 1929, 33 pp.

[19] Robinson, George M., A Brief History of the Clifton-Morenci District: Min. Cong. Jour., vol. 15, June, 1929, p. 436.

Mosier, McHenry, and Sherman, Gerald, Mining Practice at Morenci Branch, Phelps Dodge Corporation, Morenci, Ariz.: Min. Cong. Jour., vol. 15, June, 1929, p. 439.

Crowfoot, Arthur, and Barnard, Dale C., Concentrator of the Phelps Dodge Corporation, Morenci Branch: Min. Cong. Jour., vol. 15, June, 1929, p. 448.

Simcox, I. J., The Clifton Smelter of the Phelps Dodge Corporation: Min. Cong. Jour., vol. 15, June, 1929, p. 455.

[20] Manning, R. I. C., and Soule, Thomas, Safety at the Morenci Branch of the Phelps Dodge Corporation, Morenci, Ariz.: Inf. Circ. 6351, Bureau of Mines, October, 1930, 28 pp.

A new anode casting plant at the Clifton smelter was completed during the year. The new equipment has a capacity of 2,500 tons of copper a month and is similar in design to the one installed at the Copper Queen smelter at Douglas. Anodes (700 pounds each) are cast for shipment to El Paso, Tex., but provision was also made to cast various copper shapes. The new equipment is described in detail in the article on the Clifton smelter, also referred to in footnote 19. The company report continues:

> No. 6 hoisting shaft was sunk to the 1,800 level and the Joy shaft to the 1,400 level. The diamond drilling of the Clay low-grade ore body was continued through practically the entire year.
>
> Remodeling the concentrator to treat 5,000 tons per day is nearly completed.
>
> Not only was there an unusual amount of extraordinary development and installation work carried on preparatory to ore extraction from the lower lift of the Humboldt mine, but also a large footage of diamond drilling was done in the Clay ore body as well as much engineering work in connection with the low-grade ore program.

The remainder of the output from the Copper Mountain and Greenlee districts was mostly oxidized copper ore from the property of the Dover Copper Mining Co. 7 miles west of Morenci. The company shipped 2,406 tons of ore containing 329,813 pounds of copper and a little gold and silver to El Paso, Tex., for smelting. Most of the ore was produced in the course of development; more than $67,000 was spent in 1929 in drifting, raising, etc. The property has been a small producer since 1926; the output in 1929 greatly exceeded that in previous years.

Other producers of copper ore in the two districts were the Consolation, Eagle Gold & Copper, H. C. White, and Bianes & Pitts properties.

MARICOPA COUNTY

Fifteen lode mines in Maricopa County produced 18,353 tons of ore, a decrease of 3,948 tons from the output in 1928. Of the total ore 17,181 tons were concentrated and yielded 2,646 tons of concentrates having a total value in metals of $185,680. The ore treated by amalgamation amounted to 181 tons and yielded gold and silver valued together at $1,912. The first-class smelting ore amounted to 990 tons and yielded metals valued at $33,373. Placer gold valued at $160 was reported by two operators, and a small quantity of gold and silver bullion valued at $840 was cleaned up from an old mill. The total value of the metal output decreased from $311,948 in 1928 to $221,965 in 1929. Most of the output was copper-lead ore, containing considerable gold and silver, from the Belmont-MacNeill mine of the Tonopah Belmont Development Co. The decrease in the total output of the county was due almost entirely to curtailment at the Belmont-MacNeill mine.

Big Horn district.—For the first time since 1926 a small production was reported from the Big Horn district. The output consisted of two cars of oxidized copper ore from the dump of the Hauxhurst property, formerly known as the U. S. Copper mine. The ore was hauled 20 miles north to Aguila, a station on the Atchison, Topeka & Santa Fe Railway.

Blue Tank district.—A small lot of oxidized copper ore was marketed from the D. & D. property 30 miles southeast of Salome.

Cave Creek district.—The Missouri Copper Co. worked the Mexican Hill group 6 miles northeast of Cavecreek and shipped two cars of oxidized copper ore to the smelter at Superior.

Ellsworth district.—A car of siliceous gold ore from the Marion group 11 miles southwest of Aguila was shipped to Hayden for smelting.

Magazine district.—The property of the Red Rover Copper Co. 52 miles northeast of Phoenix was operated by lessees who shipped to the smelter at Hayden about 500 tons of oxidized copper ore averaging 49 ounces of silver to the ton and 6.565 per cent of copper. In addition to the first-class smelting ore a small quantity of milling ore was treated in a table concentrator, and the resulting copper concentrates were shipped to a smelter. Some of the concentrates averaged 265 ounces of silver to the ton.

Osborn district.—Small lots of oxidized copper ore were marketed from two prospects 20 miles southeast of Aguila.

San Domingo district.—A car of siliceous gold ore from the Dragon group of the United Vanadium Corporation was shipped to Hayden for smelting. Two placers produced gold bullion valued at about $160.

Vulture district.—Six lode mines in the Vulture district produced 17,283 tons of ore, yielding $36,760 in gold, 38,786 ounces of silver, 178,949 pounds of copper, and 1,553,860 pounds of lead, valued in all at $186,821, or $10.81 in metals a ton. All the output, except 179 tons of ore smelted and a small quantity of material cleaned up from an old mill, was copper-lead ore treated by flotation. For many years the output of the Vulture district consisted of gold bullion recovered at the Vulture property, but in 1929 the chief output in gold, silver, copper, and lead resulted from copper-lead concentrates made at the Belmont-MacNeill property of the Tonopah Belmont Development Co. near Palo Verde. The mine was worked the entire year, and more than 17,000 tons of copper-lead ore was treated in the company's 70-ton flotation plant. The resulting concentrates were hauled 26 miles to Dixie, a station on the Southern Pacific Railroad, and shipped to El Paso, Tex., for smelting. The mine is opened by an adit and a 400-foot vertical shaft; in 1929 nearly 4,000 feet of development was done in drifting and crosscutting. The ore is mostly oxidized; the chief minerals are galena, cerussite, malachite, chrysocolla, and chalcocite. The property has been productive since 1924 and a large producer of gold, silver, copper, and lead since 1927, but the known ore bodies were exhausted late in 1929 and the mine was closed January 16, 1930. The property not only ranked fourth as a producer of lead in Arizona in1929 but also produced much gold, silver, and copper. The following paragraph is taken from the company's printed annual report for the year ended December 31, 1929:

> At the Belmont-MacNeill mine it had long been recognized that to make it a really profitable and successful mine the ore bodies must be found at depth. On account of the large investment in plant and equipment the management felt justified in appropriating funds for carrying out the work recommended, after careful and painstaking geologic mapping and examination, for solving the complicated system of flat faults which cut off the veins at depth. This work was prosecuted throughout the year, and a definite conclusion that further development was not warranted having been reached on January 16, 1930, the mine was finally closed and the flotation plant and mine equipment were sold.

Other producers in the Vulture district were the Abeja and Giron mines and four small prospects near Hot Springs Junction. The property of the Vulture Mining & Milling Co. was idle in 1929.

Winifred district.—The Jack White property 18 miles northeast of Phoenix was operated by the Maricopa Mining Co. Two cars of siliceous gold ore were shipped for smelting and nearly 200 tons of ore were treated by amalgamation.

MOHAVE COUNTY

In Mohave County 40 lode mines and 4 old tailings dumps produced 10,569 tons of ore, old tailings, etc., a decrease of 20,989 tons from the output in 1928. The output of gold decreased from $301,878 to $147,682, copper from 37,329 to 24,926 pounds, zinc from 150,319 to 133,414 pounds; the output of silver increased from 30,233 to 33,429 fine ounces and lead from 161,004 to 161,417 pounds; and the total value of the five metals decreased from $343,446 to $188,861. The large decrease in the output of gold was due to the marked decline in the output of gold ore from the Katherine mine at Katherine. The ore treated by amalgamation or cyanidation, mainly the latter, amounted to 7,993 tons which, with 40 tons of old tailings, yielded $137,466 in gold and 7,406 ounces of silver, valued together at $141,413. The ore averaged $17.69 in metals a ton. The concentrating ores (2,195 tons) yielded 372 tons of concentrates which had a total value in metals of $29,335, or an average of $78.86 a ton. Crude ore shipped to smelters amounted to 321 tons and had a total value in metals of $14,437, or an average of $44.98 a ton. The most important producers in the county were the Tom Reed mine at Oatman in the San Francisco district and the Katherine mine in the Union Pass district.

Cedar Valley district.—Most of the output from the Cedar Valley district was silver ore from the W. P. Carr property. The ore was treated in a flotation plant, and one car of concentrates unusually rich in silver was shipped to the Kingman sampler. Small lots of oxidized copper ore were marketed from the dumps of the Antler and Spuyten Duyvil claims of the Copper Queen branch of the Phelps Dodge Corporation, and a little siliceous gold ore and gold and silver ore were shipped from two prospects north of Yucca. No production was reported from the Leviathan mine, formerly a large producer of copper ore.

Chemehuevis district.—A little siliceous gold ore from the Dutch Flat property north of Yucca was treated by amalgamation, and bullion valued at about $500 was sent to the San Francisco Mint. No placer output was reported from the district for 1929.

Cottonwood district.—The Walkover mine 9 miles southeast of Hackberry was worked in 1929 by the Walkover Mines Co., and a small quantity of siliceous gold ore was treated by amalgamation. Early in 1930 the property was equipped with a 30-ton concentration-cyanidation plant.

Gold Basin district.—The Kiowa Gold Mining Co. operated the San Juan group near Chloride, treated a small quantity of siliceous gold ore by amalgamation, and shipped a little first-class gold ore to a smelter. The property was equipped with a new amalgamation-cyanidation mill during 1929.

Greenwood district.—A little siliceous gold ore from the Bonanza mine 2 miles east of Burro Creek was treated by amalgamation, and a little first-class gold ore was shipped to a smelter.

Indian Secret district.—The White Hills Silver Mines (Inc.) shipped a small test lot of siliceous silver ore from its property near Chloride and did about 500 feet of development in drifting and crosscutting.

Maynard district.—The Wright Creek Mines Co., operating the American Flag mine 15 miles southeast of Kingman, did a little development work in 1929, and installed additional milling equipment which increased the capacity of the flotation plant to 80 tons a day.

Music Mountain district.—The Portland & Mizpah Mining Co., operating property 23 miles north of Hackberry, treated siliceous gold ore in an amalgamation plant and shipped gold bullion to San Francisco, Calif. The recovery in the 100-ton mill was poor and the property was closed early in the year.

Owens (*McCracken and Potts Mountain*) *district.*—Three lode mines in the Owens district produced 406 tons of ore, yielding $172 in gold, 4,448 ounces of silver, 63 pounds of copper, and 95,951 pounds of lead, valued in all at $8,599, or $21.18 in metals a ton. Most of the output was lead ore from the Senator & McCracken property near Signal, operated by the McCracken Hill Mining Co. The ore was treated by table concentration and one car of lead concentrates containing considerable silver was shipped to El Paso, Tex., for smelting. The property was a large producer of lead and silver from 1922 to 1925. Two cars of first-class oxidized lead ore from the Lead Pill property near Signal were shipped to a smelter in California and a small test lot of similar material from the Parker group was also marketed.

Pilgrim district.—A little gold ore from the Pilgrim mine west of Chloride was treated in a 25-ton amalgamation mill. The vein on the 230-foot level was said to be 5 feet wide; it was wider where cut on the 330-foot level.

San Francisco district (*Oatman, Gold Road, Vivian*).—Seven lode mines, one old tailings dump, and clean-up material from two old mills in the San Francisco district produced 4,430 tons of ore, old tailings, etc., yielding $118,516 in gold and 4,068 ounces of silver, valued together at $120,684, or $27.24 a ton. The entire output, except two small lots of rich gold ore that was smelted and old mill clean-up that was shipped to a refinery in California, was gold ore and a small quantity of old tailings treated chiefly by cyanidation. The 250-ton cyanidation plant of the Tom Reed Gold Mines Co. was idle the first quarter of the year; it was operated, however, for nine months and treated 4,500 tons of gold ore from the Tom Reed mine and from two other properties in the district—the Sunnyside and Vivian. The mill was especially active during the last quarter of the year, after new ore was opened in the Tom Reed mine. The gold output of the district was chiefly from the Tom Reed mine; about half of it was recovered from ore mined by lessees. The output of gold—5,478 ounces—was virtually the same as that in 1928 but was much less than that in 1926 when the mine produced 17,650 ounces.

The property ranked eighth as a producer of gold in Arizona in 1929. No dividends were paid, although $3,094,215 has been paid in the past. Development in 1929 consisted of 100 feet of shaft sinking, 100 feet of winze sinking, and 600 feet of drifting. A large pump was installed on the 800-foot level and preparations were made to sink the shaft from the 950 to the 1,500 foot level.

Other producers of gold ore in the district were the Arabian, Keystone-Wedge, Sunnyside, and Vivian mines. No development was done in 1929 at the United Eastern or Pioneer properties, but gold bullion was marketed as a result of a clean-up from both mills. A small quantity of old tailings from the Tom Reed dump was re-treated by cyanidation for testing purposes.

No production was reported for 1929 from the Empire (Mossback), Highland Chief, United American, United Republic, and Western Apex groups, but considerable development was done on these properties.

Union Pass district.—The Katherine Gold Mining Co., which owns property 33 miles west of Kingman, operated its mine about five months and the 250-ton cyanidation mill two months. Nearly 2,500 tons of siliceous gold ore was treated in July and August, 1929, compared with nearly 18,000 tons in 1928, and the gold output decreased nearly 6,000 ounces. The company was thrown into bankruptcy late in the year and the mine closed. A test lot of gold ore from the Texas prospect east of the Katherine mine was shipped to the Kingman sampler.

Wallapai district (Cerbat, Chloride, Kingman, Mineral Park, Stockton Hill).—Seventeen lode mines in the Wallapai district produced 1,849 tons of ore and old mill clean-up material, yielding $6,171 in gold, 10,224 ounces of silver, 19,393 pounds of copper, 64,296 pounds of lead, and 133,414 pounds of zinc, valued in all at $27,889, or $15.08 in metals a ton. Of this output 179 tons were first-class smelting ore, 1,591 tons were concentrating ore, 61 tons were treated by amalgamation, and 18 tons were old mill clean-up material shipped to a smelter.

The Pay Roll Mines (Inc.), operating the Pay Roll group near Chloride, was the largest producer in the district in 1929. Nearly 1,400 tons of complex copper-lead-zinc ore were treated in the company's new 50-ton flotation plant, which ran three months during the summer. Two cars of copper-lead concentrates were shipped to to the smelter at Douglas, Ariz., and four cars of zinc concentrates to Amarillo, Tex. The property, however, was closed late in the year as a result of the drop in metal prices. The Oro Plata group at Cerbat, owned by the Golconda Extension Mining Co., was worked by the Copperconda Mines Co. during the last six months of 1929. The new company did considerable development in drifting, crosscutting, and raising, which opened a large body of complex lead-zinc ore of milling grade. More than 200 tons of this ore were shipped to a custom flotation plant near Salt Lake City, Utah, where it was separated into lead concentrates and zinc concentrates.

The Monarch Lead Co., operating the Schuylkill and Tennessee group near Chloride, completed a new 125-ton flotation plant early in 1929, but only a small quantity of lead-zinc ore was treated, chiefly for testing purposes. The mill is equipped with a jaw crusher, a Marcy ball mill, a Dorr classifier, and Minerals Separation flotation machines. The property is opened by a vertical shaft 1,400 feet deep and by a winze to the 1,600-foot level. Considerable development was done in 1929, and two cars of lead-zinc ore were shipped to Midvale, Utah, for milling. The Hamilton Mines Co. operated a property 2 miles east of Cerbat and treated a small quantity of gold ore in a 25-ton amalgamation mill. The Hidden Treasure mine near Chloride was idle in 1929, but a small quantity of mill clean-up material containing chiefly lead was shipped to Douglas for smelting. The remainder of the district output consisted of oxidized copper ore and siliceous silver ore from the Evahom mine, sulphide copper ore from the Alpha property, siliceous gold ore from the Towne group, oxidized lead ore from the St. Louis mine, and miscellaneous small shipments from several prospects near Chloride. No production was reported in 1929 from the Banner and Prince George groups of the Old Colony Mines (Ltd.), but more than 6,000 feet of development was done. The Cornwall Mining Co. did about 900 feet of development at the White Horse group at Mineral Park.

Weaver district.—A small lot of siliceous gold ore from the Golden Door mine north of Chloride was treated by amalgamation; no production was reported from the Dixie Queen mine.

PIMA COUNTY

In Pima County the production of all metals was less in 1929 than in 1928, and the output of ore decreased from 3,688,350 to 3,617,735 tons. The output of copper decreased from 81,836,702 to 73,861,331 pounds, but as a result of the higher average sale price of the metal the total value of the output increased from $11,784,485 to $12,999,594. Gold decreased from $393,849 to $310,613, silver from 234,024 to 215,255 fine ounces, and lead from 829,671 to 817,004 pounds. The total value of the metal output increased from $12,363,359 to $13,476,409. No zinc was produced in 1928 or 1929. The concentrating ores (2,457,041 tons) yielded 114,475 tons of concentrates—nearly all copper concentrates from Ajo—which had a total value in metals of $9,764,674. Ore of shipping grade aggregated 37,944 tons and yielded metals valued at $571,380. Many small lots of miscellaneous ore, mined by operators from neighboring districts in Pima and Pinal Counties, were handled through the Tucson Chamber of Mines and shipped in bulk to Hayden, Ariz., and El Paso, Tex. No ore originating in Pima County in 1929 was treated by amalgamation or cyanidation. The placer output amounted to $505 in gold and 9 ounces of silver.

Ajo district.—Almost all of the output of the Ajo district was from the New Cornelia mines. The flotation plant, the capacity of which was increased from 5,000 to 15,000 tons, and the 5,000-ton leaching plant were operated throughout the year. Ore containing malachite, chalcopyrite, bornite, and chalcocite is mined from an open pit by steam shovels. The output of copper was more than 10 per cent less than in 1928, but the property continued to rank fourth as a producer of copper and gold in Arizona in 1929; it ranked eighth as a producer of silver. According to a statement of the Calumet & Arizona Mining Co. the output of the property in 1929 was about 71,000,000 pounds of copper, 155,739 ounces of silver, and 14,739 ounces of gold from concentrates and from ore leached. The ore concentrated amounted to 2,456,304 dry tons, averaging 1.278 per cent of copper, of which 1.196 per cent occurred in sulphide form and the remainder in oxidized copper minerals. Of the total ore mined 1,122,031 tons was carbonate ore, averaging 1.056 per cent of copper, which was leached.

The soluble copper in the carbonate ore averaged 0.984 per cent and the insoluble copper 0.072 per cent. In addition to the concentrating and leaching ores, 55 tons of ore containing 33.42 per cent of copper were shipped to the smelter at Douglas. Dividends paid to stockholders in February, 1929, amounted to $900,000, making a total of $18,630,000 since 1918. Since February, 1929, dividends paid from the profits of the New Cornelia mines have been included with those of the Calumet & Arizona Mining Co. There was no great change in the quantity of ore treated in the leaching plant, but there was a small decrease in the quantity of ore milled and in the quantity of copper recovered from sulphide ore treated by flotation. The New Cornelia Copper Co. was consolidated with the Calumet & Arizona Mining Co. in April, 1929, after which the property at Ajo was operated as the New Cornelia mines. Dividend payments, profit and loss statements, and mining and milling data are included in the printed report of the Calumet & Arizona Mining Co. for the year ended December 31, 1929. The report continues:

> In the development of the new approach additional tonnages of carbonate and sulphide ores were encountered, extending it beyond the originally planned slope lines. Completion of the approach has been retarded by reason of mining these additional tonnages of ore.
>
> Six diamond drill holes were completed and three other holes were started but not finished at the end of the year. A total of 8,444 feet of drilling was done. These holes have developed a substantial tonnage of sulphide ore of commercial grade.
>
> All units in connection with the operations of the plants are in good operating condition.
>
> Three additional No. 7 Symons cone crushers were installed in the fine-crushing plant, replacing the No. 8 gyratory crushers and horizontal Symons disk crushers.
>
> All rod mills in the concentrator were extended 3 feet from 12 to 15 feet in length and equipped with 300 horsepower motors.
>
> All six foot classifiers were replaced with eight foot classifiers.
>
> The Inspiration type flotation cells were replaced by MacIntosh flotation cells.
>
> An appropriation was approved for the following construction and changes:
>
> A three-unit extension to the concentrator with auxiliaries; extension to ore bins and changes in the roll plant for screening of ores before delivery to the mill; a 7,500 kilowatt turbine and auxiliaries for the power plant; three steam shovels and seven locomotives for the mine; the removal of compressor house and other mine buildings.
>
> The progress of this work is as follows:
>
> The mill, auxiliaries, and extensions to ore bins are 85 per cent complete. The changes in the roll plant about 50 per cent complete. The erection of the 7,500 kilowatt turbine, condenser, and auxiliaries is complete and the remainder of the work about 90 per cent complete. Steam shovels and locomotives have been received. Compressors and steel sharpening shop have been moved to their new location near the new approach and the new mine office building is completed.

The remainder of the district output consisted of small lots of oxidized copper ore from two prospects near Ajo.

Amole district.—The Southwestern Metal Mines (Inc.) operated the Tucson group 5 miles southwest of Tucson and shipped several cars of oxidized copper ore to Hayden for smelting. Small lots of oxidized copper ore were also marketed from the Bee Hive and Arizona properties.

Arivaca district.—The Amado Mining Co. operated the Rosebud property under bond and lease and shipped one car of oxidized lead ore and a small lot of lead concentrates to Douglas for smelting.

Development in 1929 consisted of sinking a vertical shaft 100 feet and drifting 300 feet. About 200 feet of tunnel work was done at the Edwards property 3 miles south of Arivaca, and a small test lot of copper-lead ore was marketed. The remainder of the district output consisted of oxidized copper ore and a little lead ore from three prospects near Arivaca. No production was reported in 1929 from the Arivaca King mine 3 miles north of Arivaca, but the Calizona Mining & Milling Co. did about 100 feet of shaft sinking and 200 feet of drifting.

Baboquivari district.—The Allison (Chance) mine 72 miles southwest of Tucson, an important producer of gold and silver from 1924 to 1928, was idle in 1929; the property was operated by the Tom Reed Gold Mining Co. in 1928. The district output in 1929 was much smaller than that in 1928 and consisted of small lots of siliceous gold ore from the Papago Chief and Valley View claims.

Cababi district (*Comobabi*).—The Como-Pima Mining Corporation worked the Little Mary mine in 1929 and treated a small quantity of copper-lead ore in the company's flotation mill; copper-lead concentrates containing considerable silver were shipped to El Paso, Tex., for smelting.

Cerro Colorado district.—The output of the Cerro Colorado district consisted of several hundred tons of siliceous silver ore and a small lot of copper-lead ore from the Mary E. mine, a small quantity of oxidized copper ore from the Silver Hill property, and a test lot of sulphide lead ore from the New Colorado mine.

Empire district.—Seven lode mines in the Empire district produced 1,067 tons of ore, yielding $557 in gold, 4,518 ounces of silver, 17,038 pounds of copper, and 438,339 pounds of lead, valued in all at $33,579, or $31.47 in metals a ton. Most of the output was oxidized lead ore, chiefly from the Gopher, Lone Mountain, Chief, and Red Cloud properties. Other producers of oxidized lead ore were the 49, Lead Carbonate, and Prince mines. A little oxidized copper-lead ore was marketed from the Red Cloud property.

Greaterville district.—Two placers and five lode mines in the Greaterville district produced 248 tons of ore, $916 in gold, 2,259 ounces of silver, 10,545 pounds of copper, and 62,082 pounds of lead, valued in all at $7,887. The ore had an average value of $29.75 in metals a ton. More than half of the ore produced in the district in 1929 was oxidized and sulphide lead ore from the Conglomerate (Reese) property, operated by lessees. The remainder of the district output consisted chiefly of first-class sulphide lead ore from the St. Louis mine and sulphide copper-lead ore from the Comstock group. A small quantity of lead ore and siliceous gold ore was marketed from two prospects near Greaterville; sluicing operations at two placers yielded bullion valued at $510.

Growler district.—A small lot of oxidized copper ore from the Growler property 20 miles southwest of Ajo was shipped to Miami for smelting.

Helvetia district.—Six lode mines in the Helvetia district produced 756 tons of ore, yielding $34 in gold, 852 ounces of silver, 84,823 pounds of copper, and 2,774 pounds of lead, valued in all at $15,592, or $20.62 in metals a ton. About half of the output was sulphide copper ore from the Peach claim of the Rosemont group 25 miles southeast of Tucson. Most of the remainder of the district output was copper ore from the Forbes and Clum properties near Sahuarita. A small quantity of copper ore was also produced from the Blue Rock mine, and test lots of copper ore and copper-lead ore from several prospects in the district were treated by flotation at the mill of the Minerals & Metals Corporation at Sahuarita.

Papago district—The Shafer Mining & Milling Corporation operated the Sunshine property and treated several hundred tons of lead ore in a small gravity-concentration plant; lead concentrates and a little first-class smelting ore were shipped to Douglas for smelting. The property was formerly operated by the Ramsdell Mines Co.; it had been inactive since 1926.

Pima district (*Olive, San Xavier, Helmet Peak, Twin Buttes*).—Ten lode mines and one smelter dump in the Pima district produced 6,205 tons of ore and old slag, yielding $357 in gold, 7,785 ounces of silver, 331,865 pounds of copper, and 147,802 pounds of lead, valued in all at $72,227, or $11.64 in metals a ton. The output in 1929 represented a marked increase over that in 1928, when the metal output was valued at $3,462. Nearly all the district output in 1929 was first-class smelting ore. The Buttes Copper Co., the largest producer, was organized early in the year to operate the Midland, Venus, and adjoining property at Twin Buttes; work in 1929, however, was confined to the Venus group. The output consisted of about 5,300 tons of sulphide ore containing 2.88 per cent of copper and a little silver. The company reports that 90,000 tons of ore containing about 1 ounce of silver to the ton and 2.5 per cent of copper have been blocked out. A lessee operating the Franklin property at Helmet Peak shipped about 250 tons of oxidized and sulphide lead ore to the smelters at Douglas, Ariz., and El Paso, Tex. A few hundred tons of copper ore from prospects in the district were treated in the flotation plant of the Minerals & Metals Corporation at Sahuarita; the resulting copper concentrates were shipped to smelters. The remainder of the district output consisted chiefly of first-class oxidized lead ore from four properties near Helmet Peak. Several cars of dump ore and slag were shipped from an old smelter site 12 miles south of Tucson, and several small lots of copper ore and lead ore produced from prospects in the district were received and sampled by the Tucson Chamber of Mines and shipped in bulk to the smelters at Hayden, Ariz., and El Paso, Tex.

Quijotoa district.—A small quantity of first-class oxidized copper ore was marketed from a prospect near Covered Wells.

Sheridan district.—No output was reported from the Sheridan district in 1929, but the Montizona Copper Co. operated a property 40 miles southwest of Casa Grande for nine months and did considerable development work.

Silver Bell district.—Eight lode mines and one smelter dump in the Silver Bell district produced 30,056 tons of ore and slag, yielding $1,873 in gold, 12,485 ounces of silver, 2,383,794 pounds of copper, and 54,142 pounds of lead, valued in all at $431,487, or $14.36 in metals a ton. As in previous years, the El Tiro and Imperial mines at Silverbell, both operated by the American Smelting & Refining Co., were the chief producers in the district. The output from the El Tiro mine was chiefly copper ore but included several hundred tons of copper-lead ore. The combined output of the two mines was slightly less than in 1928, although the output of copper ore from the

Imperial mine increased. The production of recoverable copper from both properties was about 2,200,000 pounds, compared with about 2,800,000 pounds in 1928. The Silver Hill Mines Co. (Inc.) shipped nearly 700 tons of first-class oxidized copper ore from the Silver Hill property 45 miles northwest of Tucson, and lessees shipped several cars of similar material from the Old Verde mine 4 miles east of Silverbell. The remainder of the district output consisted of oxidized copper ore from the Blue Jay and Goon properties and from two prospects near Silverbell and several hundred tons of copper material cleaned up from the old Sasco smelter site 8 miles south of Red Rock.

PINAL COUNTY

In Pinal County 39 mines and 1 smelter dump produced 3,893,128 tons of ore and old slag, an increase of 372,457 tons. The gold increased from $188,469 to $209,768, silver from 1,133,942 to 1,240,771 fine ounces, copper from 105,349,386 to 105,817,156 pounds, and lead from 453,944 to 679,569 pounds. The total value of metals increased from $16,048,466 to $19,537,731. Nearly all the ore, or 3,843,522 tons, was of concentrating grade and yielded 282,369 tons of concentrates, chiefly copper concentrates. First-class ore (48,386 tons) and old slag (979 tons) were smelted, and siliceous gold ore (241 tons) was treated by amalgamation. Nearly all the ore of milling grade came from the mines in the Mineral Creek (Ray) and Pioneer (Superior) districts, and most of the first-class smelting ore came from the Pioneer district.

Banner district.—A small part of the Banner district extends from Gila County into Pinal County; no output was reported in 1929 from the part of the district in Pinal County.

Bunker Hill district (*Copper Creek*).—Three lode mines in the Bunker Hill district produced 1,004 tons of ore, yielding $1,034 in gold, 17,428 ounces of silver, 93,777 pounds of copper, and 475,299 pounds of lead, valued in all at $56,772, or $56.55 in metals a ton. The output consisted of 634 tons of first-class smelting ore and 370 tons of ore that was concentrated; it was the largest output recorded in the district since 1926. The milling product was copper-lead ore from the Bunker Hill mine at Sombrero Butte southeast of Winkelman. The ore was treated in a small flotation plant; the resulting concentrates and a little first-class copper-lead ore were shipped to Douglas for smelting. The output of the property in 1929 was considerably less than that in 1928. Most of the smelting ore from the district was sulphide copper-lead ore from the Blue Bird mine 35 miles southeast of Winkelman, operated by the Fields Mining Corporation. Lessees shipped three cars of oxidized copper ore from the Copper Giant property of the Calumet & Arizona Mining Co.

Casa Grande district.—Three lode mines and one old slag dump in the Casa Grande district produced 2,709 tons of ore and old slag, yielding $510 in gold, 8,593 ounces of silver, and 169,514 pounds of copper, valued in all at $34,924, or $12.89 in metals a ton. The production in 1929 represented an increase over that in 1928 and the value of the output was the largest ever recorded in the district. The entire output was first-class ore and slag shipped to smelters. Most of the product was oxidized copper ore from the Lake Shore mine near Casa Grande. One car of oxidized copper ore and nearly 1,000 tons of old copper slag were shipped from the old Reward dump 35 miles south of Casa Grande. The Silver Reef Mining & Milling Co. worked the old Silver Reef property and shipped several hundred tons of siliceous silver ore to Hayden for smelting.

Goldfields district.—Three lode mines in the Goldfields district produced 221 tons of siliceous gold ore, which was treated by amalgamation; the resulting bullion was valued at $1,165. The chief producer was the Goldfield (Young) mine of the Apache Trail Gold Mining Co. This mine was operated about six months; it produced gold ore that was treated in a 10-stamp amalgamation mill. In December the property was under lease and bond to the Metallurgical Research & Mining Co., of Denver, Colo. A small quantity of siliceous gold ore from the Enterprise property 20 miles east of Mesa was treated by amalgamation, and a little gold bullion from a prospect near Mesa was shipped to San Francisco, Calif.

Mineral Creek district (*Ray, Kelvin*).—Five lode mines in the Mineral Creek district produced 3,610,423 tons of ore, yielding $21,642 in gold, 62,314 ounces of silver, 66,286,791 pounds of copper, and 175,331 pounds of lead, valued in all at $11,732,376, or $3.25 in metals a ton. In the value of metal output the Mineral Creek district was exceeded by only four districts in the State—Verde, Warren, Globe, and Ajo. The output consisted of 1,323 tons of first-class ore, 3,609,100 tons of mill ore which was reduced to 186,564 tons of concentrates, and a little copper from mine-water precipitates. As in the past year, most of the output was from the Ray mines, worked by the Nevada Consolidated Copper Co. There was an increase of nearly 12 per cent in the quantity of ore from the Ray mines milled at Hayden in 1929 and an increase of more than 7 per cent in the concentrates produced; there was a decrease of 3 per cent in the output of copper, due to the treatment of ore of lower grade, and decreases in the output of gold and silver. Both the mine and the mill were operated the entire year, and the 12,000-ton concentrator was operated as an all-flotation plant. The property produced 3,609,769 tons of ore, of which 3,609,100 tons were treated at the Hayden mill and 669 tons of ore, averaging a little more than 2 per cent of copper, were shipped to the smelter for converter lining. The mining cost, excluding depreciation and taxes but including all other overhead expenses, was 82.75 cents a ton, compared with 68.83 cents a ton in 1928. The milling cost was 39.45 cents a ton, compared with 39.9 cents a ton in 1928. The gross copper contained in the concentrates made at Hayden was 68,247,840 pounds, compared with 70,387,501 pounds in 1928; the first-class ore and the precipitates shipped to the smelter contained 61,395 pounds of copper. The net production for the year from all sources, after smelter losses were deducted, was estimated to be 66,259,703 pounds, compared with 68,616,451 pounds in 1928. The property ranked fifth as a producer of copper in Arizona in 1929 and was a large producer of gold and silver. The mine is developed by vertical shafts and drifts; 38,577 feet of work were done in 1929. The report continues:

> There was no development work carried on or prospect drilling done during the year at the Ray mines for the further exploration of ore reserves, except such exploratory work as was necessary to determine the ore limits in the active mining areas. * * *
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> At Ray mines underground operations were resumed at the No. 1 main hoisting shaft in January and again suspended in August. At the No. 2 shaft mining operations were actively carried on throughout the year on a three-shift basis,

and the usual development work done to keep pace with the output from this shaft, which was the highest in its history, the average daily tonnage mined being 9,458 tons as compared with 8,885 tons for the previous year. Exploratory headings driven to the west and northwest reached the limits of commercial ore on the second level, and during the present year development headings will be driven to explore this territory on lower horizons. In the southwest corner of the ore body the ore limits were also reached on the second and third levels; development headings now being driven in this direction from the fourth level of the mine have disclosed some extension of the ore body at lower depths than was indicated by the original churn drilling, and there appears to be a possibility that there may be further minor ore extensions in a southwesterly direction. A permanent ventilating shaft on the Senate claim was sunk and concreted during the year, and the main exhaust fan is now being moved from its former temporary location and installed at the top of the Senate shaft. * * *

At Ray mines section No. 8 of the Hayden concentrator was remodeled and placed in commission with the same equipment as the other seven sections, except that in the fine-crushing department the two 42-inch rolls were replaced by a 9-foot by 12-foot rod mill. With the eighth section in commission the Hayden concentrator is capable of handling at least 12,000 tons a day.

An article[21] on the mining practice at the Ray property was published in 1929, and an article[22] on the milling operations was published early in 1930.

The remainder of the district output consisted of several hundred tons of first-class oxidized lead ore from the Ray Silver-Lead property operated under lease by the Phelps Dodge Corporation, three cars of oxidized copper ore from the Dunham property at Ray Junction, 140 tons of oxidized copper ore from the Indian Springs group also at Ray Junction, and a little sulphide copper ore and oxidized lead ore from the Rocky Hills group 2 miles north of Ray.

Mineral Hill district.—Five lode mines in the Mineral Hill district produced 230 tons of ore, yielding $255 in gold, 162 ounces of silver, 7,468 pounds of copper, and 12,952 pounds of lead, valued in all at $2,471. The Jumbo Lead Mines (Inc.) operated a property 9 miles southwest of Superior and treated nearly 100 tons of lead ore in a 20-ton table-concentration plant; the resulting lead concentrates were shipped to Douglas for smelting. Three cars of oxidized copper ore were marketed from the Hargett property near Florence and small lots of similar ore were shipped from the Fox and Quartzsite groups also near Florence. A small quantity of gold ore from a prospect near Price was treated by table concentration and the resulting gold concentrates were shipped to Hayden for smelting.

Old Hat district.—Six lode mines in the Old Hat district produced 284 tons of ore, yielding $274 in gold, 559 ounces of silver, and 35,846 pounds of copper, valued in all at $6,881, or $24.23 in metals a ton. Most of the output was first-class copper ore shipped by lessees from the Daily group on Marble Peak near Oracle. Copper ore was also marketed from the Catalina, Red Hills, and Winchester (Castro) groups and from two prospects near Oracle.

Owl Head district.—Four cars of first-class oxidized copper ore from the Last Chance mine 30 miles southeast of Florence were shipped by a lessee to the smelter at Hayden and one car of similar material was shipped from the Dady group.

Pioneer district (*Superior*).—The Pioneer district extends into Gila County; all the production in 1929, however, came from Pinal County.

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[21] Thomas, Robert W., Mining Practice at Ray Mines, Nevada Consolidated Copper Co., Ray, Ariz.: Inf. Circ. 6167, Bureau of Mines, September, 1929, 27 pp.

[22] Garms, W. I., Concentrator Methods and Costs at the Hayden Plant of the Nevada Consolidated Copper Co., Ariz.: Inf. Circ. 6241, Bureau of Mines, February, 1930, 25 pp.

Four lode mines in the Pioneer district produced 274,778 tons of ore, yielding $183,734 in gold, 1,128,492 ounces of silver, 39,115,497 pounds of copper, and 1,161 pounds of lead, valued in all at $7,669,621, or $27.91 in metals a ton. The output consisted of 232,333 tons of ore of milling grade, which was reduced to 95,626 tons of concentrates, and 42,445 tons of first-class ore (chiefly copper ore). As in the past, the largest producer in the district was the Magma Copper Co. which operated its mine, mill, and smelter at Superior the entire year. The quantity of ore produced in 1929 increased about 2.5 per cent over that in 1928; the output of copper increased 7 per cent, gold 13 per cent, and silver 16 per cent. The mine ranked third as a producer of silver in Arizona in 1929, sixth as a producer of gold, and tenth as a producer of copper.

According to the annual printed report of the company the Magma mine produced a total of 269,579 tons of ore of all classes, containing an average of 7.62 per cent of copper and 3.92 ounces of silver and 0.036 ounce of gold to the ton. Lessees mined 593 tons of oxidized smelting ore from above the 650-foot level; this ore averaged 8.58 per cent of copper and 10.42 ounces of silver and 0.039 ounce of gold to the ton. Most of the ore mined by the company was concentrated in the 600-ton combined gravity and flotation plant. The mill ore averaged 7.05 per cent of copper and the tailings 0.20 per cent, and extraction was 98.31 per cent of the copper. The concentrates, several thousand tons of first-class smelting ore, and 21,046 tons of custom concentrates and crude ore were treated in the company's 450-ton smelter at Superior. The total net smelter production, after all losses including refining were deducted, was 38,235,310 pounds of copper, 1,158,735 ounces of silver, and 13,405 ounces of gold, of which 1,718,799 pounds of copper, 127,200 ounces of silver, and 3,209 ounces of gold were produced from ores and concentrates purchased. The average net cost of producing copper, after the value of gold and silver was deducted, was 9.987 cents a pound, compared with 9.227 cents a pound in 1928. This cost does not include any allowance for depletion or Federal taxes but includes State and county taxes (about 0.98 cent a pound), depreciation, and all other fixed and general expenses. The average net selling price received for copper in excess of all commissions and delivery charges was 18.2061 cents a pound. In 1929 development consisted of 7,735 feet of drifting, 5,655 feet of raising, 498 feet of shaft sinking, and 4,897 feet of crosscutting, a total of 18,785 feet; total development to date was reported as 159,955 feet.

Dividends paid to stockholders by the Magma Copper Co. from its organization to January 15, 1930, amounted to $8,438,558, of which four dividends totaling $1,938,736 were paid in 1929; a dividend of $510,194 was declared payable January 15, 1930. The dividend rate was increased in March, 1930, from $1 to $1.25 a share. Income from the sales of copper amounted to $6,998,766, and gold and silver sales amounted to $949,379; after various expenses were deducted the net gain for the year was $3,004,765, and the balance December 31, 1929, was $1,599,685. The following paragraphs are taken from the company's annual report for 1929:

> From No. 5 shaft development work was carried on from the 2,800 level, the 2,550 level, and the 2,250 level. On the 2,250 level drifting was done to the west of the shaft, and from the west drift several crosscuts were driven through the vein. * * *

No. 11 crosscut south is about the western end of the ore shoot on this level. Work done on this level to date has developed an ore shoot as shown by the crosscuts enumerated above approximately 450 feet long. On the 2,550 level the west drift was driven to a point 1,525 feet west of No. 5 shaft. From the west drift several crosscuts were driven through the vein. * * *

Development on the 2,550 level shows an ore shoot approximately 700 feet long. Six crosscuts have been driven through the ore on this level.

The minerals in the vein are chalcopyrite and bornite. The ore developed to date in this section of the mine is lower in grade than in the main ore shoot. On the 2,800 level the west drift was started the latter part of the year and is being driven to develop the vein found on the levels above. It has not yet been driven far enough to reach the ore shoot on this level. On the 2,800 level a crosscut was driven to the north approximately 1,000 feet, and from it a drift was driven east a distance of 910 feet. From near the face of the drift a raise was driven to the 2,550 level of the mine. * * * In the north crosscut from No. 5 shaft, at a distance 820 feet north of the shaft, the Magma vein was encountered and crosscut. The vein was 24 feet wide. * * *

In order to provide ventilation for the area west of No. 5 shaft, it was decided to sink a shaft to the west of No. 5 shaft. * * *

No. 2 shaft was sunk a distance of 188 feet and at the end of the year was down to the 2,915 level. This shaft is now being sunk to the 3,250 level. The concreting of this shaft was finished during the year. * * *

The concentrator operations were continuous during the year. To mill the tonnage produced from the mine it was not necessary to run the three sections of the concentrator. * * *

Smelter operation during the year was uninterrupted, except for ordinary repair work.

Articles [23] describing the mining and milling methods and costs at the Magma mine were published in 1929 and 1930.

The Reymert mine 8 miles southwest of Superior was again operated by lessees, who shipped nearly 5,000 tons of first-class siliceous silver ore to the Magma smelter at Superior. The output of silver, however, decreased from about 120,000 ounces in 1928 to about 82,000 ounces in 1929. The property is not developed to great depth but is opened by shallow workings along the outcrop. The Belmont Copper Mining Co. did 2,466 feet of drifting and 5,673 feet of diamond drilling at the Belmont property in 1929. A new pump was installed on the 1,450-foot level, and in December new ore containing about 9 per cent of copper was opened on the 1,400-foot level. The 50-ton flotation plant erected in 1928 was idle in 1929 and the only production in 1929 was one car of sulphide copper ore of smelting grade. A small quantity of oxidized copper ore from the Bomboy group 13 miles from Superior was shipped to the Magma smelter. The Silver Bell Consolidated Mining Co. reported no production in 1929 but plans to deepen the shaft and to erect a small flotation mill in 1930.

Ripsey district.—The Florence Lead & Silver Mines (Inc.) operated its property 10 miles south of Wooley the entire year and shipped several hundred tons of siliceous silver ore to the Magma smelter at Superior. The property is opened by a vertical shaft 500 feet deep and by 1,500 feet of drifts and crosscuts.

Sacaton (Blackwater) district.—About 300 feet of tunnel work was done at the Sacaton property 10 miles west of Florence, and the operators shipped several hundred tons of oxidized copper ore to Hayden for smelting.

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[23] Snow, Fred W., Mining Methods and Costs at the Magma Mine, Superior, Ariz.: Inf. Circ. 6168, Bureau of Mines, September, 1929, 32 pp.
Rose, J. H., and McNabb, J. C., Milling Methods and Costs at the Concentrator of the Magma Copper Co., Superior, Ariz.: Inf. Circ. 6319, Bureau of Mines, August, 1930, 20 pp.

Saddle Mountain district.—In 1929 the Hope Metals Co. operated the Adjust group 11 miles east of Winkelman and completed the construction of a new 50-ton flotation plant. Several hundred tons of lead ore were treated in the mill and the concentrates were shipped to Douglas for smelting. The lead concentrates are chiefly valuable for the silver content, which averaged nearly 100 ounces to the ton. The mill is equipped with a gyratory crusher, a Hardinge ball mill, a Dorr classifier, and K. & K. flotation machines. Three cars of low-grade sulphide copper ore, extracted from the Senator mine during the sinking of a new shaft, were marketed early in the year.

Silver Bell district.—Lessees operating the Copper Blossom property 12 miles northeast of Florence shipped several cars of oxidized copper ore and one car of oxidized lead ore to Hayden, Ariz., and El Paso, Tex., for smelting.

Summit district.—The American mine 12 miles west of Miami was operated by lessees who shipped 189 tons of first-class oxidized copper ore to the smelter at Miami.

Superstition district.—A little gold ore from the Apache claim was treated by amalgamation, and bullion valued at about $200 was marketed in California.

Wooley district.—One car of sulphide copper ore produced from the Little Bertha mine 1 mile west of Wooley Gulch was shipped to the Magma smelter at Superior.

SANTA CRUZ COUNTY

Thirty-eight lode mines and dumps in Santa Cruz County produced 46,338 tons of ore, old tailings, and slag, or 13,453 tons more than was reported by 35 producers in 1928. Ore of shipping grade amounted to 7,898 tons and yielded metals valued at $164,220. Ore to concentrating mills amounted to 37,840 tons and produced 3,175 tons of lead concentrates, 2,615 tons of zinc concentrates, and 97 tons of copper concentrates, yielding metals valued at $562,802. The total value of the metal output increased $326,272, chiefly as a result of the mining and milling of lead-zinc ore at the Montana mine near Ruby.

Harshaw district.—Nine lode mines in the Harshaw district produced 3,557 tons of ore, yielding $1,024 in gold, 47,987 ounces of silver, 28,813 pounds of copper, and 201,325 pounds of lead, valued in all at $44,355, or $12.47 in metals a ton. The output consisted of 357 tons of first-class ore of smelting grade and 3,200 tons of concentrating ore which was reduced to 459 tons of concentrates. Most of the concentrating material was lead ore from the World's Fair and Trench Josephine mines, operated by the Trench Mining Co. The ore was treated in a 60-ton flotation mill and reduced to about 400 tons of lead concentrates containing considerable silver. Several cars of siliceous silver ore and first-class lead ore were also marketed from the World's Fair mine. The remainder of the milling material was lead ore from the Hardshell mine, operated by the Big Jim Mines (Inc.). The ore was treated in the company's small flotation plant at the Abe Lincoln property, and the concentrates and one car of first-class oxidized lead ore were shipped to El Paso, Tex., for smelting. Lessees operating the El Ruido mine 7 miles southeast of Patagonia shipped three cars of oxidized copper ore of smelting grade.

The remainder of the district output consisted of small lots of first-class lead ore produced from the Mono, Flux, and Black Eagle mines and from two prospects near Patagonia.

Nogales district.—A small test lot of sulphide lead ore was marketed from the Silent Friend group near Nogales.

Oro Blanco district.—With the exception of a test lot of oxidized copper-lead ore produced from the Oro Blanco property the entire output of the Oro Blanco district was silver-lead-zinc milling ore from the Montana mine of the Eagle-Picher Lead Co. near Ruby. The mine is opened by a vertical shaft 640 feet deep; about 2,000 feet of development was done in 1929. The ore is silver-lead-zinc material of milling grade containing galena, sphalerite, tetrahedrite, chalcopyrite, and pyrite. The capacity of the milling plant was increased from 250 to 300 tons a day, and new Fahrenwald flotation machines were installed supplanting the original gravity and flotation equipment. The mill was idle from January 19 to August 19 because of a shortage of water, but a new pumping plant on the Santa Cruz River (a distance of 15 miles) was completed in August and milling operations were continuous the remainder of the year. The output in 1929 increased more than 50 per cent over that in 1928, and the property was the largest producer of zinc in Arizona in 1929 and ranked second as a producer of lead and seventh as a producer of silver.

Pajarito district.—The output of the Pajarito district consisted of small test lots of first-class oxidized lead ore from the Morning mine and a little lead ore of milling grade from the Sunset mine. The ore from the Sunset mine was treated in a small jigging plant.

Palmetto district.—The output of the Palmetto district was chiefly sulphide copper ore from the Three "R" mine 5 miles north of Flux. The property was operated by the Three "R" Mines (Inc.), and nearly 3,200 tons of sulphide copper ore containing about 253,000 pounds of copper was shipped to smelters. A small quantity of old tailings from the Three "R" dump was treated by leaching and scrap-iron precipitation, and the resulting copper precipitates were also shipped to a smelter. A 140-ton flotation mill on the property was idle in 1929, but the company reported about $9,400 spent on development. The remainder of the district output consisted of small lots of copper ore from the Gray and Georgia Morris properties and a little lead ore from the Hassayampa mine.

Patagonia (*Washington, Duquesne*) *district.*—Eleven lode mines and old dumps in the Patagonia district produced 5,137 tons of ore, old tailings, and slag, yielding $1,565 in gold, 7,344 ounces of silver, 604,441 pounds of copper, and 8,830 pounds of lead, valued in all at $112,417, or $21.88 in metals a ton. The entire output, except 45 tons of old slag resmelted and 500 tons of ore treated in a concentration plant, was first-class ore and old tailings smelted. The Southern Copper Mining Co., operating the Santo Nino mine, was the largest producer in the district. The company shipped several thousand tons of sulphide copper ore to the smelter at Douglas, Ariz., by way of Zorilla, Sonora, Mexico, and also marketed three cars of molybdenum ore. The ore contains chalcopyrite and molybdenite. About $13,000 was said to have been spent on development in 1929. Lessees operating the Gladstone-Proto group 17 miles northeast of Nogales shipped about 250 tons of first-class sulphide copper ore to the smelter at Douglas and did about 500 feet of development in

1929. The ore averaged 3.40 ounces of silver to the ton and 8.50 per cent of copper. More than 500 tons of copper ore from the Morning Glory mine were concentrated in a small flotation plant; the resulting concentrates were shipped to Hayden for smelting. Lessees worked the Duquesne group northeast of Nogales and shipped two cars of first-class sulphide copper ore; a total of several hundred tons of old tailings, containing chiefly silver and copper, from the Holland dump at Duquesne was shipped to Douglas for smelting. The remainder of the district output consisted of small lots of first-class copper ore from the Roy and Arizona European groups, a little first-class copper-lead ore from the Happy Thought claim, a little siliceous gold ore from the Twin Bell property, a small lot of lead ore from the Tres de Mayo mine, and a car of slag containing chiefly lead from the old Mowry dump.

Tyndall district (*Alto*).—Six lode mines in the Tyndall district produced 125 tons of first-class smelting ore, yielding $392 in gold, 1,746 ounces of silver, 12,771 pounds of copper, and 29,198 pounds of lead, valued in all at $5,410, or $43.28 in metals a ton. Nearly all the district output came from the Alto property 13 miles west of Patagonia; this property was operated by lessees who marketed several lots of sulphide copper ore, copper-lead ore, and lead ore. The remainder of the district output consisted of small lots of first-class ore from the Apache & Bonanza, Salero, Standard, Three Stars, and Warsaw claims. The Jefferson mine, the largest producer in the district in 1928, was idle in 1929.

Wrightson district.—The output of ore from the Wrightson district in 1929 consisted of a car of first-class sulphide copper ore from the Gringo group 4 miles north of Patagonia, a little first-class sulphide copper-lead ore from the Mohawk property, a little first-class lead ore from the Victor mine, and test lots of copper-lead ore and lead ore from the Dixie mine.

YAVAPAI COUNTY

The production of all metals, except lead and zinc, in Yavapai County showed large increases in quantity. There were 81 mines producing, 17 more than in 1928. The output of ore, old slag, etc., increased from 1,890,830 to 2,255,441 tons, gold from $1,404,620 to $1,693,404, silver from 2,619,217 to 2,810,859 fine ounces, and copper from 165,296,914 to 208,171,605 pounds; the output of lead decreased from 162,780 to 153,613 pounds; no zinc was marketed from mines in Yavapai County in 1929, compared with 21,207 pounds in 1928. The total value of the metals increased from $26,750,353 to $39,839,473; it was larger than that of any county in the State and showed the largest increase.

Of the total (1,646,417 tons) first-class ore shipped to smelters 1,626,079 tons was sulphide copper ore. The total smelting ore yielded on the average $20.50 in metals a ton. Concentrates amounting to 108,833 tons, derived from 607,902 tons of milling ore, yielded metals valued at $6,001,465. No concentrates were produced at gold and silver mills in 1929. Gold and silver bullion valued at $853 was recovered from 14 tons of ore treated by amalgamation and 40 tons of old tailings cyanided. Miscellaneous material, including old mill and smelter clean-up, old slag, and old matte shipped for resmelting, yielded gold, silver, and copper valued at $15,938; copper from precipitates was valued at $59,216. The placer output was $4,634 in gold and 31 ounces of silver, compared with $3,912 in gold and 30 ounces of silver in 1928.

Agua Fria district.—The output of the Agua Fria district consisted of about 1,400 tons of dump ore and old slag, containing chiefly copper, from property owned by the Copper Mountain Mines Co., several hundred tons of first-class oxidized copper ore from the Binghampton mine near Mayer, and one car of similar material from the Binghampton Extension mine, also near Mayer. The district output was much larger than in 1928. The Copper Mountain Apex Mines (Ltd.) reported about 800 feet of tunnel work done in 1929 on the Barbara group, but no ore was shipped. A little development was also done at the property of the Verde Standard Copper Co.

Big Bug district.—Three placers, eight lode mines, and two dumps in the Big Bug district produced 2,322 tons of ore and old mill and smelter clean-up, $4,587 in gold, 20,788 ounces of silver, 159,938 pounds of copper, and 60,175 pounds of lead, valued in all at $47,607. The ore and clean-up were valued at $20.43 in metals a ton. The output consisted of 600 tons of ore concentrated, 1,606 tons of crude smelting ore, and 116 tons of old mill and smelter clean-up. Placer bullion valued at $175 in gold was recovered from operations on Big Bug Creek. The Blue Bell mine 5 miles south of Mayer was the largest producer in the district in 1929. The property, owned by the Southwest Metals Co., was worked by lessees who shipped about 800 tons of oxidized copper ore of smelting grade. The copper smelting plant at Humboldt, also owned by the Southwest Metals Co., was reconditioned late in 1929 and placed in operation in February, 1930. Two cars of clean-up material from the smelter site were marketed. The Arizona National property was operated by the Double O Metals Co.; 600 tons of lead ore were treated in a 50-ton flotation plant. Two cars of lead concentrates and two cars of first-class sulphide lead ore, containing considerable silver, were shipped to El Paso, Tex., for smelting. The company reported about 900 feet of development done in 1929, chiefly in drifting. A lessee shipped more than 300 tons of copper ore from the dump of the Hackberry (Boggs) group 1 mile southwest of Arizona City. Several cars of first-class sulphide copper ore were shipped from the Lone Pine property 2 miles south of Humboldt. The remainder of the district output consisted of two cars of siliceous gold ore and a little mill clean-up material from the Gladstone-McCabe property 4 miles southeast of Humboldt, one car of sulphide copper-lead ore of smelting grade from the Kizer Wilhelm group 1½ miles west of the Poland tunnel, one car of first-class copper ore from the Lottie mine, and a small quantity of siliceous gold and silver ore from the Rebel & Little Kicker group 2½ miles southwest of Humboldt.

Black Canyon district.—Five lode mines in the Black Canyon district produced 158 tons of ore, yielding $784 in gold, 1,250 ounces of silver, 5,282 pounds of copper, and 536 pounds of lead, valued in all at $2,414, or $15.28 in metals a ton. With the exception of 3 tons of milling ore the entire output was first-class smelting ore, consisting of one car of oxidized copper ore from the Great Republic group 3 miles east of Cleator, one car of similar material from the New Year mine also near Cleator, two cars of siliceous gold and silver ore from the Gold Crown (old Silver Chord) mine, and one car of siliceous gold ore from the Republic mine 1½ miles north of Bumble Bee. The Cutler property of the Silver Pheasant Mines (Inc.) was idle in 1929, but a small quantity of lead concentrates containing considerable silver was marketed. The Howard Copper Co. reported about 400 feet of development done in 1929, chiefly in drifting, but no ore was shipped. The Arizona Western Mining & Milling Co. did about 100 feet of shaft sinking at the Turkey group 1½ miles southwest of Cleator.

Black Hills district.—The output of the Black Hills district consisted of 628 tons of copper ore from the dump of the old Yaeger property. The ore, which contained an average of about 2 ounces of silver to the ton and 3.4 per cent of copper, was shipped to the smelter at Hayden.

Black Rock district.—Four lode mines in the Black Rock district produced 236 tons of ore, yielding $689 in gold, 224 ounces of silver, and 30,668 pounds of copper, valued in all at $6,205, or $26.29 in metals a ton. Most of the output was oxidized copper ore from the dump of the Amazon mine 16 miles east of Wickenburg and similar material from the Willis property also near Wickenburg. Small lots of copper ore from the Unida and Roberts & Bouden groups were shipped to the smelter at Superior. The Arizona Copper Belt Mining Co. reported more than 1,000 feet of development at its property 12 miles northeast of Wickenburg. A little development was also done at the Red Mountain property near Constellation.

Blue Tank district.—Small shipments of oxidized copper ore were made from three properties in the Blue Tank district. The producers were the Sam Jones property 12 miles northeast of Wickenburg, the Sahuaro 2½ miles northeast of Wickenburg, and a prospect near by.

Castle Creek district.—The output of the Castle Creek district consisted of a small lot of high-grade siliceous gold ore from the Wallie & Rattlesnake (Golden Aster) group and a little silver ore from the Rainbow mine concentrated in a small table mill. Considerable surface development was reported by the Mardis Mining Co.

Copper Basin district.—A car of first-class sulphide lead ore was shipped from the U. S. Navy group by the Verde Annex Mines Co., a car of siliceous gold ore was shipped from the Gold Chief mine, and a test lot of lead ore was marketed from a prospect near Skull Valley. A small quantity of placer bullion was recovered from operations on Copper Creek and from Copper Basin Wash. About 1,300 feet of tunneling was reported at the Nine Strike mine 12 miles southwest of Skull Valley.

Copper Creek district.—A car of first-class oxidized copper ore was shipped from the Copper Queen claim 18 miles southeast of Cordes.

Eureka district.—Five lode mines in the Eureka district produced 11,562 tons of ore, yielding $2,003 in gold, 1,176 ounces of silver, 278,248 pounds of copper, and 26,900 pounds of lead, valued in all at $53,297, or $4.61 in metals a ton. Nearly all the district output was copper ore of milling grade from the Bagdad property 28 miles from Hillside, operated by the Bagdad Copper Corporation. The property is opened by a 370-foot vertical shaft and by 8,000 feet of of tunnels. A churn-drilling campaign was reported to have indicated more than 30,000,000 tons of ore averaging about 1.5 per cent of copper, which occurs chiefly as chalcocite and chalcopyrite. A 50-ton experimental flotation plant was completed early in 1929; during the year the plant treated 11,444 tons of ore and produced 348 tons of concentrates averaging nearly 40 per cent of copper. Most of the concentrates and one car of first-class oxidized copper ore were shipped to Superior for smelting, and the remainder was treated locally in an experimental plant equipped for roasting, leaching, and electrolysis. An article[24] describing the operations at the Bagdad property was published in November. In 1929 the company did 370 feet of shaft sinking, 85 feet of raising, and 3,752 feet of drifting and installed new surface equipment, new machinery, and a power plant. The remainder of the district output consisted of gold ore, treated by amalgamation, from the Helen K. property, a car of first-class sulphide lead ore from the Last Chance group, a car of gold ore of smelting grade from the Bland mine, and a little siliceous silver ore and lead ore from the Hollywood group.

Hassayampa district.—Two placers and nine lode mines in the Hassayampa district produced 4,638 tons of ore, $24,690 in gold, 10,453 ounces of silver, 148,726 pounds of copper, and 10,690 pounds of lead, valued in all at $57,111. The ore was valued at $12.21 in metals a ton. The placer output consisted of $482 in gold and 5 ounces of silver. Of the total ore produced, 1,338 tons were directly smelted and 3,300 tons were concentrating ore. All of the material concentrated was copper ore from the Storm Cloud mine treated in a 50-ton flotation plant. The output in 1929, however, was considerably less than that in 1928. About 1,000 tons of gold ore from the Ore Flame mine, 11 miles south of Prescott, were shipped to Superior for smelting. The ore contained 913.32 ounces of gold, 2,529 ounces of silver, and 12,676 pounds of copper. The mine is opened by a tunnel; 300 feet of drifting was done in 1929. The Midnight Test mine at the head of Groom Creek, 10½ miles southeast of Prescott, was operated by the Midnight Test Mines (Inc.) until September, when it was purchased and operated by the National Exploration Corporation. Several cars of siliceous gold ore, containing 13 ounces of silver to the ton and a little copper, were shipped by both companies. The property is opened by a vertical shaft 425 feet deep and by 2,000 feet of drifts. Development in 1929 consisted of 500 feet of drifting, 400 feet of raising, and 100 feet of tunnel work, said to have blocked out 25,000 tons of ore containing gold and silver valued at about $20 a ton. Construction of a 50-ton gravity and flotation plant was completed early in 1930. The Senator property of the Phelps Dodge Corporation was operated by lessees who shipped a car of first-class sulphide lead ore and a car of siliceous gold and silver ore to Douglas for smelting. The remainder of the district output consisted of one car of high-grade copper ore from the Lookout property, 13 miles south of Prescott, a car of silver ore from the Monte Cristo mine on Groom Creek, a little first-class oxidized lead ore from the Dandy mine, 10 miles southwest of Prescott, a test lot of copper ore from the Mother Lode Extension claim, and a small quantity of gold ore of smelting grade from a prospect near Prescott. Placer bullion was marketed by several operators working claims on the Hassayampa River. The Blue Dick property and the Emporia mine, large producers in 1928, were idle in 1929. About 3,000 feet of drifting was done at the Sheldon Superior property by the Chase Mines (Inc.), and a new 100-ton flotation plant was under construction at the Davis-Dunkirk property.

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[24] Baroch, Charles T., Flotation, Roasting, and Electrolytic Problems in the Development of a Copper Extraction Process: Eng. and Min. Jour., vol. 128, Nov. 30, 1929, p. 845.

Humbug district.—A test lot of copper ore was shipped from the Copper Chief property, and a new 150-ton flotation plant was under construction at the property of the Golden Wonder Mines (Inc.).

Martinez district.—Two cars of siliceous gold ore were shipped from the Blue Bird property, 3 miles north of Congress Junction. The Southwest Metal Extraction Co. erected a 400-ton cyanide plant to re-treat the large dump of old tailings at the Congress mine, but the initial run was not made until 1930.

Peck district.—There were only two producing mines in the Peck district in 1929; as substantial increases in output were recorded at both properties the district output was considerably larger than in 1928. The value of the output increased from $152,174 to $251,858. The De Soto mine, owned by the Southwest Metals Co., was operated by lessees who shipped more than 15,000 tons of oxidized copper ore to various smelters in Arizona. No work, however, was done on company account as the smelter at Humboldt was idle. The Gold Crown Silver Mining Co. continued to operate the Swastika property, 1 mile east of Peck Canyon, and shipped several hundred tons of siliceous ore exceedingly rich in silver and a small lot of oxidized lead ore. A little development, mostly shaft sinking, was reported by the Southwest Metal Mines (Inc.) at its property 1 mile south of Cleator.

Pine Grove district.—Old tailings from the Saratoga dump at Crown King were treated by cyanidation, and the resulting gold and silver bullion was sold to a refinery in California. The Silver Crown Mining Co. treated a little lead ore by flotation and marketed a small lot of lead concentrates rich in silver.

Silver Mountain district.—A test lot of first-class lead ore from the Dean property, 10 miles south of Crown King, was shipped to El Paso, Tex.

Tiger district.—One car of sulphide copper ore from the Springfield property, 3 miles west of Crown King, was shipped to the smelter at Hayden, and a little placer bullion was recovered from operations on Minnehaha Flats 6 miles southwest of Crown King.

Tip Top district.—A small quantity of silver ore was shipped from the Tom Wade mine, and a little oxidized copper ore was marketed from the Ben Warner claims, both near Canon. Considerable development, chiefly diamond drilling, was done at the Kay mine by the Kay Copper Corporation 14 miles south of Cleator. The mine is opened by a shaft and winze to the 1,500-foot level.

Verde district (*Jerome*).—The value of the output of the Verde district in 1929 was again the largest district output in Arizona. The exact output of the district is not given in this report, as the United Verde Copper Co. publishes no annual report and objects to having its production made public. The output of the district consisted of copper ore of concentrating and smelting grade from the United Verde mine, first-class copper smelting ore from the United Verde Extension mine, copper ore of concentrating grade from the Verde Central mine, and a little siliceous silver ore from the Hosford property. The entire district output of first-class ores and concentrates was reduced to blister copper at large copper smelters at Clarkdale and Clemenceau. More than half of the district output was from the United Verde mine.

In 1929, as in previous years, the United Verde mine ranked first in the output of gold, silver, and copper in Arizona. The company's mine at Jerome and mill and smelter at Clarkdale were operated continuously in 1929. About 73 per cent of the total ore produced from the mine during the year was of smelting grade and was shipped directly to the smelter at Clarkdale. The 5,000-ton smelter is equipped with both blast furnaces and reverberatories, but all blast-furnace smelting was discontinued during November, 1929, and all copper material is now treated by roasting, reverberatory smelting, and converting. The remainder of the mine output was treated in the company's 1,200-ton flotation plant, also at Clarkdale, and the resulting concentrates were shipped to the smelter. Although about 60 per cent of the mine output came from underground operations in 1929, a large quantity of ore was mined from the open pit; these operations were described in detail in an article[25] published early in 1930. The underground portion of the mine is opened by lower adit tunnels and two shafts to the 3,150-foot level. During 1929 the company did 25,180 feet of development and began an extensive shaft-sinking program which will extend over three years and will ultimately open the 5,000-foot level. The most recent description[26] of the underground mining operations at Jerome appeared in 1928. A detailed article[27] on the milling methods at the concentrator at Clarkdale was published in 1930.

Most of the ore from the United Verde Extension mine was treated in the company's copper smelting plant at Clemenceau, but nearly 35,000 tons of highly siliceous copper ore was shipped to Hayden for use as a converter lining. The mine and 800-ton smelter were operated continuously, and the property ranked fifth in the production of gold and silver in Arizona in 1929 and sixth in copper. The smelter at Clemenceau treated 326,203 tons of company ore, which averaged 8.66 per cent of copper and 0.039 ounce of gold and 1.64 ounces of silver to the ton; the yield was 54,133,064 pounds of copper. The siliceous copper ore shipped to Hayden contained 4,934,849 pounds of copper, as well as gold and silver. Custom ore and concentrates purchased and treated at the smelter (16,912 tons) contained 5,044,018 pounds of copper, as well as gold and silver. The custom material was chiefly copper concentrates from the Verde Central mill. The cost of producing a pound of copper from the United Verde Extension mine was as follows: Mining, 2.47 cents; smelting, 2.33 cents; freight on ore, 0.08 cent; freight (on bullion), refining, and selling, 1.72 cents; and other expenses, 1.86 cents; a total of 8.46 cents a pound. This cost does not include depreciation, depletion, or taxes. Gross revenue from the sale of bullion (including that from custom material) and ore amounted to $11,780,473, which, when added to other revenue ($351,008), amounted to $12,131,481. Deductions of charges for mine and smelter operations, ores and concentrates purchased, freight, refining, selling, and other expenses, including taxes, amounted to $6,217,178. Earnings from operations were $5,914,303, and after $2,925,405 was deducted for depletion and depreciation there remained a net profit of $2,988,898. Dividends paid to stockholders in 1929 amounted to $3.75 a share, or $3,937,500, making a total dividend disbursement of $34.85 a share, or $36,592,500, paid since the organization of the company in 1916. At the smelter, reverberatory furnace No. 1 was operated 305 days; No. 2, 320 days; and the blast furnace, 198 days. The report continues:

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[25] Alenius, E. M. J., Methods and Costs of Stripping and Mining at the United Verde Open-Pit Mine, Jerome, Ariz.: Inf. Circ. 6248, Bureau of Mines, February, 1930, 34. pp.

[26] Robie, E. H., Innovations at the United Verde Mine: Eng. and Min. Jour., vol. 125, Apr. 14, 1928, p. 611.

[27] Kuzell, C. R., and Barker, L. M., Milling Methods and Costs at the Concentrator of the United Verde Copper Co., Clarkdale, Ariz.: Inf. Circ. 6343, Bureau of Mines, September, 1930, 28 pp.

> Operations were continuous both in the mine and at the smelter during the year. * * *
>
> Underground development during the year from the 550 level to the 1,800 level consisted of 2,360 feet of raises and 15,719 feet of drifts. * * *
>
> The tonnage of ore mined is increased for the year and the grade is lower, but the ore body above the 1,200 level produced an increase of tonnage over last year's estimated measurements, so that we find in reserve about 625,000 tons of about 7½ per cent ore.

A detailed description[28] of the mining practice at the mine was published early in 1930.

The Verde Central Mines (Inc.) placed its new flotation mill in operation in January, 1929, and treated 93,050 tons of ore averaging 2.70 per cent of copper from the Verde Central mine. The new mill was described in an article[29] published in August. Changes in the mill and the addition of a 3-foot Symons cone crusher and new MacIntosh flotation machines increased the capacity of the plant to 300 tons a day. The concentrates were smelted at the United Verde Extension smelter at Clemenceau, and the Verde Central Mines (Inc.) reported a production of 4,335,261 pounds of copper and 19,796 ounces of silver. The mine is opened by a vertical shaft 1,900 feet deep; 1,487 feet of development was done in 1929. The operations were reviewed in the annual report of the Calumet & Arizona Mining Co. for 1929, from which the following paragraphs are taken:

> Development work consisted of 1,143 feet of drifting and crosscutting and 344 feet of raising, and 57 per cent of this work was done in prospecting new areas and the remainder in developing known ore bodies. Development work was very limited because all hoisting capacity was required for ore production. When stopes are emptied of ore they will be filled with waste rock and thus increase our development program.
>
> Drift 1,410 is being driven southward on the quartz-porphyry-greenstone contact, with the aim of prospecting this contact and also prospecting under the favorable showings on the 1,000 level in the Crown Point, Butte, and Apex claims. The face of this drift has reached a point about 700 feet south of the shaft and for the last 200 feet has shown slight quartz and chalcopyrite mineralization.
>
> Ore is mined by the shrinkage method which has proved satisfactory and economical. This method entails breaking a large tonnage of ore which is not immediately withdrawn, but the cost of breaking is charged to the ore extracted this year. * * *
>
> Tests were run during the year to determine size and character of grinding media, size of feed for most economical flotation results, most suitable flotation reagents and maximum capacity of various machines. The mill is now in good shape to treat ore at a figure considerably below our 1929 costs and also to treat a tonnage in excess of 300 tons per day; 93,050 tons of ore were milled during the year with 92.1 per cent copper extraction. The concentrates averaged 21.34 per cent copper and the tails averaged 0.24 per cent copper.

Walker (*Lynx Creek*) *district.*—With the exception of placer bullion from two properties on Lynx Creek the entire output from the Walker district was copper ore of milling grade from the Sheldon mine, operated by the Sheldon Mining Co. The property is opened by an inclined shaft 1,280 feet deep; more than 5,600 feet of development was done in 1929. A 175-ton flotation concentrator at the mine treated about 17,000 tons of copper ore, which yielded copper concentrates and a small quantity of lead concentrates. Late in 1929 the Sheldon Mining Co. purchased the controlling interest in the Southwest Metals Co., which owns the copper smelter at Humboldt, the Blue Bell mine near Mayer, and the De Soto mine near Cleator. The smelting plant was reconditioned late in the year and placed in operation early in 1930. The placer output from the district amounted to $2,754 in gold and 19 ounces of silver.

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[28] D'Arcy, Richard L., Mining Practice and Methods at the United Verde Extension Mining Co., Jerome, Ariz.: Inf. Circ. 6250, Bureau of Mines, February, 1930, 11 pp.

[29] Young, George J., Verde Central in Production: Eng. and Min. Jour., vol. 128, Aug. 17, 1929, p. 249.

Walnut Grove district (*Wagoner*).—Four placers in the Walnut Grove district produced bullion yielding $451 in gold and 4 ounces of silver. The Hammon Copper Co. (Inc.) acquired the Zonia property of the Arizona Metals (Inc.) in 1929 and did considerable work in further developing the mine. No products were marketed, but the company was considering the erection of a 600-ton leaching plant.

Weaver district.—Two placers and two lode mines in the Weaver district produced 9,199 tons of ore, $72,701 in gold, 4,203 ounces of silver, 7,826 pounds of copper, and 19,966 pounds of lead, valued in all at $77,576. The placer output was valued at $711 and came from several properties near Octave. A small lot of gold ore was marketed from the A-1 & Mahogany group 2 miles northwest of Octave. The remainder of the district output consisted of more than 9,000 tons of gold ore from the Octave mine 11 miles east of Congress Junction, operated by the Arizona-Eastern Gold Mines Co. The mine is opened by an inclined shaft 1,100 feet deep; about 500 feet of development was done in 1929. The ore is concentrated in a 50-ton mill equipped with tables and flotation machines; the concentrates, containing nearly 10 ounces of gold to the ton, were shipped to the smelters at Hayden, Ariz., and El Paso, Tex. The property ranked eleventh in the production of gold in Arizona in 1929.

White Picacho district.—The Great Southern Mining Co. worked the Great Southern & Rattler group 10 miles northeast of Wickenburg and did about 500 feet of development. The Diamond Joe property of the Tindale Mining Co. (Inc.), a large producer of lead ore in 1928, was idle in 1929.

YUMA COUNTY

The total value of the production of gold, silver, copper, and lead in Yuma County was $116,357 in 1929, compared with $56,570 in 1928. There was an increase in the output of gold, silver, and copper, but a decrease in the output of lead. Thirty-two lode mines produced 6,521 tons of ore. The placer output was $353 in gold and 2 ounces of silver. Gold and silver bullion valued at $4,046 was recovered from 707 tons of ore treated in amalgamation and cyanidation plants (chiefly cyanidation plants). The chief producers in the county were the Clara-Swansea property at Swansea and the Sheep Tanks (Resolution) property 30 miles south of Vicksburg.

Castle Dome district.—Four lode mines in the Castle Dome district produced 117 tons of ore, yielding $147 in gold, 610 ounces of silver, 3,004 pounds of copper, and 36,572 pounds of lead, valued in all at $3,305, or $28.25 in metals a ton. The district output in 1928 was valued at $13,019. The 1929 output consisted of 57 tons of first-class smelting ore and 60 tons of milling ore which were reduced to 22 tons of concentrates. Most of the material concentrated was lead ore from the New Deal (De Luce) group treated by table concentration. The concentrates and a little first-class oxidized lead ore were shipped to Douglas for smelting. The Mable property near Dome also produced a little lead ore, which was treated by table concentration. One car of siliceous gold and silver ore containing copper and lead was marketed from the Bunker Hill claim, 35 miles northeast of Dome, and a car of copper ore and a little lead ore were shipped from the Copper Glance property 3 miles west of Thumb Butte Peak.

Cienega district.—Seven lode mines in the Cienega district produced 94 tons of ore, yielding $4,513 in gold, 28 ounces of silver, and 13,420 pounds of copper, valued in all at $6,890, or $73.30 in metals a ton. The Lion Hill Gold Mining Co., operating the Lion Hill mine, 8 miles northeast of Parker, was the largest producer in the district in 1929, but its output of gold was considerably less than in 1928. A small quantity of gold ore was treated by amalgamation, and a little first-class ore containing considerable gold was shipped for smelting. About 300 feet of development were done at the property in 1929. The remainder of the district output consisted of small lots of oxidized copper ore from the Black Hill, Johnson & Bunch, North Side, Yuma Chief, Sue, and Rio Vista properties.

Copper Mountain district.—Small lots of oxidized copper ore were marketed from the Last Chance and La Suerta properties near Wellton.

Ellsworth district.—Seven lode mines in the Ellsworth district produced 287 tons of ore, yielding $7,751 in gold, 222 ounces of silver, 14,425 pounds of copper, and 19,078 pounds of lead, valued in all at $11,610, or $40.45 in metals a ton. The output consisted of 283 tons of first-class smelting ore and 4 tons of ore treated at gold and silver mills. Most of the gold, silver, and lead produced in the district in 1929 came from the Bonanza & Golden Eagle property 9 miles north of Salome. The property was operated by lessees who shipped two cars of rich gold ore and three cars of first-class oxidized lead ore containing considerable gold; a small test lot of gold ore was also treated by cyanidation. A small quantity of gold bullion was cleaned up from the old mill at the Harqua Hala property and shipped to San Francisco, Calif. The remainder of the district output consisted of small shipments of copper ore from the Arizona Big Indian, Critic, Wenden Copper, and Iron Cap properties. About 2,000 feet of development was done at the property of the Wenden Copper Mining Co., 400 feet of crosscutting was done at the Britannia Gold Mines property, and about 800 feet of drifting was done at the Harqua Hala Extension property.

Kofa district.—The Sheep Tanks (Resolution) property in the Alamo Mountains 30 miles south of Vicksburg was worked for nine months by the Ibex Mines; the output consisted of 801 tons of siliceous gold ore of smelting grade containing 1,303.27 ounces of gold, 12,525 ounces of silver, and a little copper. The property was a new producer in 1929; it ranked fourteenth in the production of gold in Arizona. A little copper-lead ore from the Boss Mineral mine 20 miles northwest of Palomas was hauled to Kofa and shipped to the smelter at Douglas.

Planet district.—The Clara-Swansea property at Swansea was under lease until August to E. C. Lane, who shipped more than 2,500 tons of first-class sulphide copper ore to the smelter of the United Verde Extension Mining Co. at Clemenceau. In August the American Smelting & Refining Co. acquired the property under lease and shipped 1,578 tons of similar material to the smelter at Hayden. The total output of the mine in 1929 was 4,215 tons of ore containing 281,178 pounds of copper and a little silver. Churn drills were installed at the mine the latter part of the year to determine the size and grade of the ore body, and a mill was under construction in January, 1930.

Plomosa district.—Three placers and six lode mines in the Plomosa district produced 215 tons of ore, $1,577 in gold, 202 ounces of silver, and 28,602 pounds of copper, valued in all at $6,719. The ore had an average value of $29.60 in metals a ton. Placer bullion yielding $353 in gold and 2 ounces of silver was recovered from operations near Quartzsite. With the exception of a little gold ore from the Garfield group, treated by amalgamation, the entire district output was first-class smelting ore. The Little Butte Amalgamated Mines Co. shipped more than 100 tons of oxidized copper ore from its property 4 miles west of Bouse. A car of similar material produced from the Dutchman-Blue Slate group by the Protection Gold & Copper (Inc.) was shipped to the smelter at Hayden. Small lots of copper ore were also marketed from three prospects near Bouse.

Santa Maria district.—One car of lead concentrates was cleaned up from the old mill at the East Side property 8 miles east of Swansea and shipped to Douglas for smelting.

Silver district.—The Silver Mines Consolidated treated about 700 tons of siliceous silver ore from the James G. Blaine property in an 80-ton cyanidation plant, and the resulting silver bullion was marketed in California. The property has been a small producer of silver from low-grade ore since 1926, but after March, 1929, it was in the hands of creditors as a result of the low price of silver. A little high-grade oxidized lead ore from the Big Rock property was shipped to El Paso, Tex., for smelting.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA[1]

(MINE REPORT)

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SUMMARY

The value of the mine production of gold, silver, copper, lead, and zinc in Montana in 1929 was $71,779,547, or nearly 30 per cent more than that in 1928, largely because of the great increase in the output of copper. There were also large increases in the output of silver and lead, but decreases in gold and zinc; the output of zinc decreased more than 29,000,000 pounds. In 1929 Montana ranked second in the production of silver in the United States, after Utah; third in copper, after Arizona and Utah; and fourth in zinc, after Oklahoma, Kansas, and New Jersey.

An exact summary of the value of the metal output of Montana by years has never been compiled, but an estimate of $1,099,019,699 was given by the Director of the Mint[3] for the gold, silver, copper, and lead produced from 1862 to 1903. Adding to this total the value of these metals and that of zinc from 1904 to 1929 gives a total of $2,741,879,316 for the State from 1862 to the end of 1929.

The total value of the mine production of gold, silver, copper, lead, and zinc in Montana from 1904 to 1929, as recorded in Mineral Resources of the United States, has been $1,642,859,617. Details of production are as follows: Ore, old tailings, etc., 131,476,669 short tons; gold, $75,909,834; silver, 325,110,585 fine ounces; copper, 6,604,126,346 pounds; lead, 529,326,820 pounds; and zinc, 2,624,501,268 pounds.

Silver Bow County, which includes the Butte or Summit Valley district, continued to produce most of the silver, copper, and zinc, and in 1929 the county produced 42 per cent of the lead and nearly half of the gold. The value of the output of the county amounted to more than 91 per cent of the total value of the metal output of the State.

Published reports show that the Anaconda Copper Mining Co., Butte & Superior Mining Co., Butte Copper & Zinc Co., and East Butte Copper Mining Co. paid dividends in 1929 amounting to $29,128,141, but part of the Anaconda dividend was paid from receipts from operations in other States. Dividend 106, declared by the Anaconda Copper Mining Co. during 1929, was not paid until February 17, 1930, and will be credited to the year 1930. No complete record of the dividends paid by mining companies in Montana

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[1] Work on manuscript completed March, 1931.

[2] The valuable assistance of Paul Luff and LaRu Shepherd, of the Bureau of Mines, is acknowledged.

[3] Director of the Mint, Ann. Rept. for 1904, p. 93.

has ever been kept, but adding the dividends of the last five years to an estimate made by one of the mining journals[4] gives a total of $408,251,528 to the end of 1929. The Anaconda, Amalgamated, North Butte, Butte & Superior, and Parrot companies have paid the larger part of this total.

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price for 1920 to 1922 is New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver	Copper	Lead	Zinc	Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*		*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1920	$1.09	$0.184	$0.080	$0.081	1925	$0.694	$0.142	$0.087	$0.076
1921	1.00	.129	.045	.050	1926	.624	.140	.080	.075
1922	1.00	.135	.055	.057	1927	.567	.131	.063	.064
1923	.82	.147	.070	.068	1928	.585	.144	.058	.061
1924	.67	.131	.080	.065	1929	.533	.176	.063	.066

Mine production of gold, silver, copper, lead, and zinc in Montana, 1920–1929, in terms of recovered metals

Year	Mines producing		Ore, old tailings, etc. (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1920	392	65	5, 241, 615	89, 550. 11	$1, 851, 165	12, 579, 178	$13, 711, 304
1921	348	97	1, 324, 801	71, 631. 91	1, 480, 763	6, 558, 713	6, 558, 713
1922	315	78	4, 385, 878	80, 145. 62	1, 656, 757	12, 468, 151	12, 468, 151
1923	304	78	5, 743, 535	85, 079. 43	1, 758, 748	13, 380, 862	10, 972, 307
1924	302	86	4, 652, 482	97, 854. 16	2, 022, 825	13, 289, 303	8, 903, 833
1925	331	93	4, 405, 008	82, 122. 85	1, 697, 630	13, 158, 191	9, 131, 784
1926	335	58	4, 470, 055	60, 504. 11	1, 250, 731	12, 769, 092	7, 967, 913
1927	247	60	4, 222, 607	53, 541. 25	1, 106, 796	11, 200, 077	6, 350, 444
1928	236	43	4, 344, 279	58, 196. 09	1, 203, 020	10, 853, 276	6, 349, 166
1929	212	40	4, 723, 445	54, 758. 03	1, 131, 949	12, 716, 977	6, 778, 149

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1920	177, 059, 260	$32, 578, 904	31, 253, 916	$2, 500, 313	184, 337, 786	$14, 931, 361	$65, 573, 047
1921	48, 098, 730	6, 204, 736	20, 366, 917	916, 511	23, 275, 966	1, 163, 798	16, 324, 521
1922	165, 754, 442	22, 376, 850	29, 767, 479	1, 637, 211	119, 069, 818	6, 786, 980	44, 925, 949
1923	224, 125, 264	32, 946, 414	35, 945, 623	2, 516, 194	141, 460, 392	9, 619, 307	57, 812, 970
1924	249, 152, 062	32, 638, 920	39, 476, 008	3, 158, 081	128, 475, 218	8, 350, 889	55, 074, 548
1925	268, 910, 847	38, 185, 340	37, 530, 644	3, 265, 166	115, 316, 922	8, 764, 086	61, 044, 006
1926	255, 372, 862	35, 752, 201	42, 306, 193	3, 384, 495	147, 401, 507	11, 055, 113	59, 410, 453
1927	223, 492, 639	29, 277, 536	35, 898, 315	2, 261, 594	160, 461, 803	10, 269, 555	49, 265, 925
1928	248, 262, 027	35, 749, 732	33, 759, 644	1, 958, 059	165, 660, 189	10, 105, 272	55, 365, 249
1929	297, 725, 973	52, 399, 771	39, 213, 707	2, 470, 464	136, 351, 734	8, 999, 214	71, 779, 547

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[4] Mining Truth, May 16, 1925, p. 93.

Gold and silver produced at placer mines in Montana, 1920–1929

Year	Gold		Silver		Year	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value		Fine ounces	Value	Fine ounces	Value
1920	13, 977. 76	$288, 946	2, 210	$2, 409	1925	1, 905. 25	$39, 385	405	$281
1921	10, 988. 91	227, 161	1, 591	1, 591	1926	1, 104. 30	22, 828	162	101
1922	3, 472. 65	71, 786	652	652	1927	1, 079. 97	22, 325	197	112
1923	1, 972. 68	40, 779	360	295	1928	865. 14	17, 884	149	87
1924	1, 323. 59	27, 361	187	125	1929	596. 66	12, 334	71	38

GOLD

The production of gold in Montana in 1929 was nearly 6 per cent less than that in 1928. Large decreases in the output of gold were reported by the New Gould Mining Co. near Wilborn in Lewis and Clark County, by the Anaconda Copper Mining Co. at Butte, and by several other companies operating in Madison and Silver Bow Counties. These decreases were partly offset by the large increase in the gold output recovered at the Spring Hill property near Helena in Lewis and Clark County. The output of gold in Montana has decreased from $5,004,195 in 1915 to $1,131,949 in 1929. Silver Bow County reported nearly half the total for the State in 1929; its output, however, decreased nearly 10 per cent compared with that in 1928. Lewis and Clark County was second in output in 1929 and was followed closely by Madison County. Amalgamation and cyanidation mills produced 8 per cent of the total gold, yielding an average of $4.78 in gold and 52 cents in silver to the ton of ore and old tailings treated. Concentrates of all kinds yielded 80 per cent of the total gold, and crude ore shipped to smelters yielded nearly 10 per cent. Dry and siliceous ore, old tailings, etc., yielded 31 per cent of the gold; copper ore, old tailings, etc., 57 per cent; lead ore and slag, 1 per cent; zinc ore and slag and lead-zinc ore and old tailings, 10 per cent; and placers, 1 per cent. There was a decrease in gold from copper ore and dry and siliceous ore, but an increase from zinc ore.

Three properties produced nearly 73 per cent of the total gold from Montana in 1929. The Anaconda property at Butte ranked first, followed by the Spring Hill mine near Helena, Lewis and Clark County, and the Liberty Montana property near Jefferson Island, Madison County. The Spring Hill mine increased its output of gold nearly 81 per cent and rose from third to second place as a producer of gold in Montana. Other large producers of gold were the Drumlummon mine near Marysville and the New Gould property near Wilborn, both in Lewis and Clark County; the Butte & Superior property at Butte, Silver Bow County; the Comet mine near Basin, Jefferson County; and the Eveline mine at Butte, Silver Bow County.

SILVER

The output of silver from mines in Montana in 1929 was 17 per cent larger than that in 1928 and was more than the yearly average of 11,897,382 ounces for the decade 1920 to 1929. The increase in the quantity of silver derived from copper ore and zinc ore from Silver Bow County accounted for most of the increase and more than offset the decrease in silver recovered from lead-zinc ore. Siliceous silver ore, chiefly from property near Kila, Flathead County, was the source of part of the increased silver production. Judith Basin County also recorded a large increase in silver due to the increased output of silver-bearing lead-zinc ore from the Block P mine. A decided decrease in the silver output was reported from Cascade County, but increases were noted in Granite and Jefferson Counties. More than 57 per cent of the total silver was obtained from copper ore, old tailings, etc., 18 per cent from lead-zinc ore and old tailings, more than 12 per cent from zinc ore and slag, and 9 per cent from siliceous silver ore and old tailings. Silver Bow County, chiefly the Butte district, produced 78 per cent of the total silver; most of the remainder came from three mines in Flathead, Judith Basin, and Granite Counties. Concentrates yielded 88 per cent of the silver, first-class smelting ore 11 per cent, old tailings, slag, etc., smelted less than 1 per cent, and bullion from ore treated at cyanidation and amalgamation mills less than one-half of 1 per cent.

Seven properties produced more than 87 per cent of the total silver from Montana in 1929; each of these yielded more than 300,000 ounces and two of them—the copper mines of the Anaconda Copper Mining Co. and the Butte & Superior mine—more than 1,250,000 ounces each. The Anaconda Copper Mining Co. produced more than half of the State's output of silver in 1929. The other five large producers were the Flathead, Block P, Emma, East Butte, and Trout properties.

COPPER

The production of copper in Montana in 1929 was 297,725,973 pounds, the largest production since 1918 when the State produced 323,174,850 pounds of copper. As the price of copper increased to an average of about 21 cents a pound in March, 1929, the large copper mines were worked at capacity most of the year. For the first half of 1929 copper production was abnormally high, but late in the year the output was curtailed. Except for 1,409,696 pounds of copper, chiefly from Cascade, Granite, Judith Basin, Jefferson, and Madison Counties, the total output of copper came from Silver Bow County, which includes the Butte district. Copper ore, old tailings, etc., yielded 99 per cent of the total copper. Concentrates yielded nearly 94 per cent of the copper and crude ore of all kinds shipped to smelters 3 per cent; the remainder (3 per cent) of the copper was saved from old tailings smelted, pond slimes, slag, and precipitates. The sulphide copper ore of smelting grade yielded 9,513,874 pounds of copper, an average of 4.57 per cent, and the oxidized copper ore 143,680 pounds, an average of 5.07 per cent. Slag resmelted, old tailings and pond slimes smelted, and copper precipitates from mine waters and ore leached yielded 8,587,745 pounds of copper.

Three properties in Montana each produced more than 3,000,000 pounds of copper in 1929. The mines of the Anaconda Copper Mining Co., including various old tailings dumps and slime ponds, yielded 95 per cent of the State's output; the other two properties were the East Butte and North Butte. Other large producers of copper were the Butte & Superior, Silver Bow lease, and Silver Dyke mines. The Anaconda Copper Mining Co. increased its output of copper more than 50,000,000 pounds or 22 per cent over 1928. Resumption of operations at the North Butte mine was an important feature of the year that contributed to the increased output of the Butte district.

LEAD

The production of lead in Montana in 1929 increased 16 per cent in quantity over that in 1928. The output of lead from Silver Bow County, which accounted for 73 per cent of the production in 1928, decreased more than 8,000,000 pounds in 1929 and amounted to 42 per cent of the State total. This unusually large decrease from Silver Bow County was due to the curtailment in lead-zinc ore shipped from the mines at Butte. A large decrease in lead output was also reported from Cascade County. The combined losses, however, were more than offset by the marked increase in the lead output of Judith Basin County, chiefly from the Block P property. Substantial increases were also reported from Jefferson, Broadwater, Lewis and Clark, Madison, and Granite Counties. Lead-zinc ore and old tailings yielded 63 per cent (80 per cent in 1928) of the lead, zinc ore and slag 21 per cent, lead ore 13 per cent, and copper-lead ore and copper-lead-zinc ore 3 per cent. Concentrates yielded nearly 84 per cent of the total output of lead, crude ore of all kinds shipped to smelters 11 per cent, and slag 5 per cent. The greater part of the lead from Montana mines, saved at East Helena, arrives at the smelter in residues from the zinc plants at Anaconda and Great Falls or in lead concentrates from the mills at Anaconda and Butte.

Five properties—the Block P (St. Joseph Lead Co.), Emma, Butte & Superior, Joe Dandy (Butte Copper Consolidated Mines), and Anaconda, each yielding more than 1,800,000 pounds—produced more than 73 per cent of the total lead. Other large producers were the East Helena slag plant and the Poser, Comet, and Silver Dyke properties.

ZINC

The production of zinc in Montana in 1929 was nearly 18 per cent less in quantity than that in 1928, but it was more than the yearly average of 132,181,133 pounds for the decade 1920 to 1929. The decrease in the production of zinc in 1929 was due to the large decrease in the output of lead-zinc ore from the mines at Butte in Silver Bow County, where a decrease of nearly 46,800,000 pounds of zinc was recorded. Large increases in zinc from mines in Judith Basin, Granite, and Jefferson Counties and from slag re-treated at East Helena in Lewis and Clark County prevented a more serious decrease in the State output. The mines at Butte, Silver Bow County, produced 74 per cent (89 per cent in 1928) of the total zinc from Montana in 1929, and most of the remainder came from the slag plant at East Helena, Lewis and Clark County, and from mines in Judith Basin, Granite, and Jefferson Counties. The Anaconda Copper Mining Co. operated continuously its electrolytic zinc plants at Great Falls and Anaconda on custom zinc products from various States and produced slab zinc at an average rate of about 380 tons a day, exclusive of the zinc recovered from dross and residue. Most of the lead-zinc ore was treated at the Timber Butte custom mill at Butte and the custom plant at Anaconda. The Butte & Superior Mining Co., which shipped its entire zinc product to Anaconda for milling, produced approximately 37 per cent of the zinc of the State and the Emma and Anaconda properties and the East Helena slag plant about 44 per cent. Zinc ore yielded 67 per cent of the zinc and lead-zinc ore nearly 33 per cent.

Three properties producing zinc ore or lead-zinc ore at Butte—the Butte & Superior, Emma, and Anaconda group—produced most of the zinc. These properties, each producing more than 19,000,000 pounds of zinc, yielded nearly 67 per cent of the State's total output. Zinc recovered from the East Helena fuming plant represented about 14 per cent of the State's output. Other large producers of zinc were the Block P (St. Joseph Lead Co.), Poser, Trout, and North Butte properties.

The following tables show the relative importance of Silver Bow County or the Butte district. Judith Basin and Lewis and Clark Counties were the only other counties in Montana that produced metals valued at more than $1,000,000 in 1929.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1929, by counties, in terms of recovered metals

County	Gold					Silver (lode and placer)	
	Lode		Placer		Total value		
	Fine ounces	Value	Fine ounces	Value		Fine ounces	Value
Beaverhead	238.78	$4,936	1.98	$41	$4,977	45,366	$24,180
Broadwater	751.80	15,541	87.46	1,808	17,349	46,396	24,729
Cascade	82.43	1,704			1,704	157,503	83,949
Deer Lodge	551.04	11,391	.49	10	11,401	645	344
Flathead	44.02	910			910	885,528	471,987
Granite	1,160.32	23,986	22.98	475	24,461	557,687	297,247
Jefferson	1,850.10	38,245	6.63	137	38,382	180,062	95,973
Judith Basin	698.53	14,440	1.02	21	14,461	784,186	417,971
Lewis and Clark	12,529.17	259,001	29.22	604	259,605	43,835	23,364
Lincoln	62.84	1,299	10.06	208	1,507	4,908	2,616
Madison	9,939.17	205,461	128.10	2,648	208,109	67,702	36,085
Meagher						6	3
Mineral	1.16	24	177.68	3,673	3,697	6,706	3,574
Missoula	1.60	33	18.19	376	409	161	86
Park	10.69	221			221	14,739	7,856
Phillips	57.08	1,180			1,180	64	34
Powell	116.69	2,412	108.50	2,243	4.655	754	402
Ravalli	6.92	143	1.93	40	183	1,823	972
Sanders			2.42	50	50		
Silver Bow	26,059.03	538,688			538,688	9,918,906	5,286,777
	54,161.37	1,119,615	596.66	12,334	1,131,949	12,716,977	6,778,149
Total, 1928	57,330.95	1,185,136	865.14	17,884	1,203,020	10,853,276	6,349,166

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaverhead	62,704	$11,036	847,788	$53,411			$93,604
Broadwater	12,224	2,151	2,412,941	152,015	97,525	$6,437	202,681
Cascade	399,911	70,384	985,225	62,069	109,156	7.204	225,310
Deer Lodge	778	137					11,882
Flathead	1,997	352					473,249
Granite	316,402	55,687	928,978	58,526	5,237,025	345,644	781,565
Jefferson	157,380	27,699	1,975,024	124,427	2,827,213	186,596	473,077
Judith Basin	293,301	51,621	12,274,961	773,323	7,770,524	512,855	1,770,231
Lewis and Clark	12,627	2,222	1,716,473	108,138	18,986,927	1,253,137	1,646,466
Lincoln	155	27	156,638	9,868	33,208	2,192	16,210
Madison	142,015	24,995	1,156,213	72,841	4,174	275	342,305
Meagher	6,606	1,163					1,166
Mineral	925	163	94,811	5,973	145,021	9,571	22,978
Missoula	690	121	2,451	154			770
Park	76	13	166,749	10,505			18,595
Phillips	31	5					1,219
Powell	693	122	10,968	691			5.870
Ravalli	1,181	208	5,912	373	40,456	2,670	4,406
Sanders							50
Silver Bow	296,316,277	52,151,665	16,478,575	1,038,150	101,100,505	6,672,633	65,687,913
	297,725,973	52,399,771	39,213,707	2,470,464	136.351,734	8,999,214	71,779,547
Total, 1928	248,262.027	35,749,732	33,759,644	1,958,059	165,660,189	10,105,272	55,365,249

Ore, old tailings, etc., sold or treated, lode mines producing, and average value of ore, etc., in gold and silver in Montana, 1928 and 1929, by counties

County	Ore, old tailings, etc. (short tons)		Lode mines producing		Average value per ton in gold and silver	
	1928	1929	1928	1929	1928	1929
Beaverhead	1,432	4,593	9	8	$19.91	$6.34
Broadwater	8,090	6,541	16	18	5.27	6.16
Cascade	199,945	48,746	8	5	1.54	1.76
Deer Lodge	488	588	3	5	20.59	19.96
Fergus	65		3		45.66	
Flathead	585	10,273	1	2	59.91	46.03
Granite	49,843	57,440	17	12	4.95	5.59
Jefferson	9,162	22,136	36	31	7.02	6.06
Judith Basin	5,633	106,751	5	5	3.41	4.05
Lewis and Clark	130,558	153,125	24	26	2.26	1.84
Lincoln	1,460	1,613	7	4	11.76	2.43
Madison	38,754	39,325	45	41	6.78	6.14
Meagher	39	27	1	2	1.10	.11
Mineral	393	449	2	2	8.31	8.00
Missoula	15	13	1	3	27.20	9.15
Park	1	415	1	2	88.00	19.46
Phillips	1,549	11	4	2	3.22	110.36
Powell	182	121	10	10	33.76	23.19
Ravalli		65		1		17.15
Sanders	37		1		15.43	
Silver Bow	3,896,048	4,271,213	42	33	1.59	1.36
	4,344,279	4,723,445	236	212	1.73	1.67

Gold and silver produced at placer mines in Montana in 1929, by counties

County	Mines		Gold	Silver (fine ounces)	Total value
	Drift	Hydraulic and sluicing			
Beaverhead		1	$41		$41
Broadwater		4	1,808	13	1,815
Deer Lodge		1	10		10
Granite		2	475	3	476
Jefferson		3	137		137
Judith Basin		1	21		21
Lewis and Clark	2	2	604	3	606
Lincoln		2	208		208
Madison	1	5	2,648	28	2,663
Mineral	1	5	3,673	9	3,678
Missoula		2	376		376
Powell		6	2,243	15	2,251
Ravalli	1		40		40
Sanders		1	50		50
	5	35	12,334	71	12,372
Total, 1928	2	41	17,884	149	17,971

MINING INDUSTRY

The mining industry in Montana in 1929 enjoyed an unusually prosperous year, as indicated by the labor conditions, the dividend payments, and the increased output of silver, copper, and lead. The average sale price of copper, 17.6 cents a pound, was the highest paid since 1920, when the average was 18.4 cents a pound. As there was a ready market in 1929 for products of metal mines, activity in mining and development was stimulated throughout the State, particularly in the copper mines at Butte.

The copper production was the largest since 1918, and dividends paid in 1929 were larger than in any year since an exact record has been kept. The previous record was for 1918, when mining companies paid $19,455,472. In addition to the marked increase recorded in the production of copper large increases were made in silver and lead. The decrease in the production of zinc was the direct result of curtailment in shipments of lead-zinc ore from mines at Butte and the gradual depletion of several bodies of lead-zinc ore in Cascade and Silver Bow Counties. These losses, however, were partly offset by the greatly increased production of lead-zinc ore from the Block P property of the St. Joseph Lead Co. in Judith Basin County. The Anaconda Copper Mining Co., which controls nearly all the large copper mines at Butte, including property purchased from the Clark estate in 1928, produced copper at an average rate of nearly 25,000,000 pounds a month in 1929. The output of the East Butte Copper Mining Co. was considerably decreased in 1929, and the company reports comparatively little ore in reserve. At the North Butte mine, however, operations were resumed and production increased greatly late in 1929 and early in 1930.

ORE CLASSIFICATION

Ore, old tailings, etc., sold or treated in Montana, 1920–1929, with content in terms of recovered metals

DRY AND SILICEOUS ORE

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1920	178,352	45,293.42	2,000,162	358,808	611,004	
1921	164,906	47,377.95	1,546,910	85,468	956,655	
1922	373,311	53,343.24	2,197,802	217,906	581,205	
1923	342,253	54,743.81	1,280,235	50,271	42,867	
1924	207,487	63,174.26	947,083	309,015	627,015	
1925	194,691	38,081.43	591,369	157,745	368,128	
1926	93,571	23,810.07	345,456	55,266	72,924	
1927	111,976	18,389.30	427,105	22,865	93,674	
1928	112,331	18,492.10	340,876	13,723	44,673	
1929	102,268	16,974.00	1,198,531	50,844	3,436	
COPPER ORE						
1920	4,002,491	18,720.88	6,030,507	[1] 172,581,159	1,847	
1921	928,461	4,733.30	1,663,472	[1] 46,888,812	1,029	
1922	3,250,213	13,367.13	5,446,684	[1] 162,860,743		
1923	4,420,601	19,776.67	7,619,864	[1] 220,471,500	1,864	
1924	3,437,931	24,926.12	7,845,180	[1] 243,927,687		
1925	3,190,841	32,352.64	8,656,401	[1] 265,201,209		
1926	3,179,051	27,289.67	7,762,190	[1] 250,247,871		
1927	2,958,445	27,241.47	6,201,827	[1] 218,647,748	1,630	
1928	3,174,509	33,546.34	5,705,513	[1] 244,708,989		
1929	3,802,976	31,030.94	7,289,007	[1] 294,697,579		
LEAD ORE						
1920	64,563	3,084.34	800,856	199,951	9,583,916	
1921	113,481	4,151.98	1,352,125	215,114	7,414,293	11,167
1922	96,203	2,783.02	647,754	33,275	8,133,697	
1923	105,450	2,368.15	437,703	184,842	8,741,531	69,560
1924	78,656	1,486.37	287,041	222,066	7,829,188	
1925	118,062	2,393.79	532,219	387,701	9,320,422	
1926	132,039	2,391.32	514,628	363,825	8,467,354	
1927	57,182	1,540.90	314,100	196,402	4,912,945	
1928	10,419	574.72	178,520	14,989	3,005,336	
1929	15,436	785.51	163,300	80,441	4,927,763	

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[1] Includes copper recovered from precipitates.

Ore, old tailings, etc., sold or treated in Montana, 1920–1929, with content in terms of recovered metals—Continued

COPPER-LEAD ORE

Year	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1920	1,787	113.83	38,685	62,508	375,072	
1921	334	10.59	26,244	24,388	166,526	
1922	21,251	659.18	122,153	204,497	518,697	
1923	106,325	271.05	340,559	598,152	1,445,059	
1924	160,883	332.74	573,038	1,181,998	2,339,877	
1925	195,327	2,113.50	555,365	1,382,541	2,576,816	
1926	224,322	331.43	668,986	1,650,177	3,910,331	
1927	263,868	314.92	559,918	1,573,206	2,812,096	
1928	192,839	284.61	402,705	804,791	2,490,272	
1929	48,059	83.20	144,382	401,578	972,896	

ZINC ORE, LEAD-ZINC ORE, AND COPPER-LEAD-ZINC ORE

1920	994,422	8,359.88	3,706,758	3,856,834	20,682,077	184,337,786
1921	117,619	4,369.18	1,968,371	884,948	11,828,414	23,264,799
1922	644,900	6,520.40	4,053,106	2,438,021	20,533,880	119,069,818
1923	768,906	5,947.07	3,702,141	2,820,499	25,714,302	141,390,832
1924	767,525	6,611.08	3,636,774	3,511,296	28,679,928	128,475,218
1925	706,087	5,276.24	2,822,432	1,781,651	25,265,278	115,316,922
1926	841,072	5,577.32	3,477,670	3,055,723	29,855,584	147,401,507
1927	831,136	4,974.69	3,696,930	3,052,418	28,077,970	160,461,803
1928	854,181	4,433.18	4,225,513	2,719,535	28,219,363	165,660,189
1929	754,706	5,287.72	3,921,686	2,495,531	33,309,612	136,351,734

Ore, old tailings, etc., sold or treated in Montana in 1929, with content in terms of recovered metals

Source	Mines producing	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	69	[1] 57,676	14,549.72	29,748	2,919	3,263	
Dry gold and silver ore	6	847	540.78	17,678	8,712		
Dry silver ore	21	[2] 43,745	1,883.50	1,151,105	39,213	173	
Copper ore	27	[3] 3,802,976	31,030.94	7,289,007	[4] 294,697,579		
Lead ore	60	[5] 15,436	785.51	163,300	80,441	4,927,763	
Zinc ore	4	[6] 430,971	1,348.14	1,576,332	1,350,430	8,440,777	91,138,518
Copper-lead ore	4	48,059	83.20	144,382	401,578	972,896	
Lead-zinc ore	38	[7] 320,069	3,925.08	2,327,493	1,041,271	24,709,487	44,879,451
Copper-lead-zinc ore	3	3,666	14.50	17,861	103,830	159,348	333,765
Total, lode mines	[8] 212	4,723,445	54,161.37	12,716,906	[4] 297,725,973	39,213,707	136,351,734
Total, placers	40		596.66	71			
	252	4,723,445	54,758.03	12,716,977	[4] 297,725,973	39,213,707	136,351,734
Total, 1928	279	4,344,279	58,196.09	10,853,276	[9] 248,262,027	33,759,644	165,660.189

[1] Includes 800 tons of old tailings cyanided, 3 tons of old slag amalgamated, and 1 ton of ashes and mill cleanings sold to a smelter.

[2] Includes 30,000 tons of old tailings concentrated.

[3] Includes 2,040 tons of ore leached and 15,879 tons of old tailings, 1 ton of old slag, and 13,043 tons of pond slimes sold to a smelter.

[4] Includes 6,555,984 pounds of copper recovered from precipitates.

[5] Includes 3,372 tons of slag sold to a smelter.

[6] Includes 100,000 tons of slag fumed.

[7] Includes 5,729 tons of old tailings concentrated.

[8] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.

[9] Includes 6,701,580 pounds of copper recovered from precipitates.

Value of metals from ore, old tailings, etc., sold or treated in Montana in 1929, by classes of ore

Class	Ore, old tailings, etc. (short tons)	Gold	Silver	Copper	Lead	Zinc	Total value
Dry gold ore	57,676	$300,769	$15,856	$514	$206		$317,345
Dry gold and silver ore	847	11,179	9,422	1,533			22,134
Dry silver ore	43,745	38,935	613,539	6,901	11		659,386
Copper ore	3,802,976	641,466	3,885,041	[1] 51,866,774			56,393,281
Lead ore	15,436	16,238	87,039	14,157	310,449		427,883
Zinc ore	430,971	27,869	840,185	237,676	531,769	$6,015,142	7,652,641
Copper-lead ore	48,059	1,720	76,955	70,678	61,292		210,645
Lead-zinc ore	320,069	81,139	1,240,554	183,264	1,556,698	2,962,044	6,023,699
Copper-lead-zinc ore	3,666	300	9,520	18,274	10,039	22,028	60,161
	4,723,445	1,119,615	6,778,111	[1] 52,399,771	2,470,464	8,999,214	71,767,175
Total, 1928	4,344,279	1,185,136	6,349,079	[2] 35,749,732	1,958,059	10,105,272	55,347,278

[1] Includes value of 6,555,984 pounds of copper recovered from precipitates.
[2] Includes value of 6,701,580 pounds of copper recovered from precipitates.

GOLD ORE

Gold ore, old tailings, etc., largely dry and siliceous, were reported from 69 mines and dumps in Montana in 1929, compared with 81 in 1928. This material, the output of which decreased 19 per cent, yielded on the average $5.21 in gold and 0.52 ounce of silver to the ton and a little copper and lead and was valued at $5.50 in recovered metals a ton. Lewis and Clark and Broadwater Counties produced most of the gold ore; the Spring Hill mine, near Helena, Lewis and Clark County, produced nearly 70 per cent of the total gold ore, with the Porphyry Dike property near Rimini and the Drumlummon mine near Marysville, also in Lewis and Clark County, following. The output of gold ore from the New Gould property in the Gould district of Lewis and Clark County decreased considerably.

GOLD AND SILVER ORE

Gold and silver ore was reported from six mines in four counties in Montana in 1929. This ore yielded on the average $13.20 in gold and 20.87 ounces of silver to the ton and a little copper. Most of the output was milling ore from the Hoffman property at Maxville, Granite County.

SILVER ORE

A total of 21 mines produced the output of siliceous silver ore and old tailings in Montana in 1929, which yielded on the average 89 cents in gold and 26.31 ounces of silver to the ton and a little copper and lead and was valued at $15.07 in recovered metals a ton. The output of this class of material was more than that in 1928, as a result of the large increase in the shipments of silver ore from the Flathead mine in Flathead County. Most of the output, however, was old silver tailings from the Granite Bimetallic dump at Philipsburg Granite County.

COPPER ORE

Copper ore, old tailings, etc., the output of which increased 20 per cent compared with 1928, were reported from 27 mines in Montana in 1929 and represented nearly 81 per cent of the total output of ore, etc., of the State. The average yield of the ore, etc., was 17 cents in gold and 1.92 ounces of silver to the ton, and 3.79 per cent of copper (75.79 pounds to the ton), exclusive of copper recovered from precipitates; the average value in recovered metals a ton was $14.53, exclusive of the value of copper from precipitates. Nearly all the copper ore was mined at Butte—largely from the Anaconda, East Butte, and North Butte properties—and most of it was milling ore. The Liberty Montana Mines Co., operating the Mammoth property near Jefferson Island, Madison County, ranked fourth as a producer of copper ore in Montana in 1929.

LEAD ORE

The output of lead ore and old slag, reported from 59 mines and one slag dump in Montana in 1929, increased from 10,419 tons in 1928 to 15,436 tons in 1929. About 22 per cent of the lead material was slag from the old Hecla dump near Melrose, Beaverhead County; no shipments were made from this dump in 1928. The average yield of the ore and slag in 1929 was $1.05 in gold and 10.58 ounces of silver to the ton, 0.26 per cent of copper, and 15.96 per cent of lead; the average value in recovered metals was $27.72 a ton. The largest producers of lead ore were the Joe Dandy mine near Radersburg, Broadwater County, and the Buckeye mine near Sheridan, the Emma mine near Twin Bridges, and the Calvin property near Melrose, all in Madison County.

ZINC ORE

The zinc material from three mines and one slag fuming plant represented 9 per cent of the total output of ore, etc., of the State and consisted of sulphide zinc ore concentrated and of slag re-treated to volatilize the zinc. The average yield of the ore and slag was 6 cents in gold and 3.66 ounces of silver to the ton, 0.16 per cent of copper, 0.98 per cent of lead, and 10.57 per cent of zinc; the average value in recovered metals a ton was $17.76. More than half of the zinc material came from the property of the Butte & Superior Mining Co., and about 23 per cent of the material was current slag from the East Helena lead smelter treated in a special plant by the Anaconda Copper Mining Co. A large quantity of zinc ore was also produced from the properties of the Anaconda Copper Mining Co. and the North Butte Mining Co. at Butte.

COPPER-LEAD ORE

Copper-lead ore of milling grade was mined chiefly from the deposit at the Silver Dyke property at Neihart, which was closed early in the year.

LEAD-ZINC ORE

The output of lead-zinc ore and old tailings in Montana in 1929 was reported from 37 mines and 1 tailings dump and represented nearly 7 per cent of the total output of ore, etc., of the State; the quantity was less than half that in 1928, as the output from the mines at Butte decreased decidedly. The average yield was 25 cents in gold and 7.27 ounces of silver to the ton, 0.16 per cent of copper, 3.86 per cent of lead, and 7.01 per cent of zinc. The average value in recovered metals a ton was $18.82. Two mines, one at Butte, Silver Bow County, and the other near Hughesville, Judith Basin County, produced nearly 67 per cent of the lead-zinc ore and old tailings. The largest producers were the Emma, Block P, Poser, Trout, Comet, Ardsley Butte, and Ardsley Butte Extension properties. Large shipments of old tailings for custom milling were made from the Comet dump near Basin, Jefferson County.

COPPER-LEAD-ZINC ORE

Three properties at Butte produced 3,666 tons of copper-lead-zinc ore, most of which came from the Lizzie mine. The average yield was 8 cents in gold and 4.87 ounces of silver to the ton, 1.42 per cent of copper, 2.17 per cent of lead, and 4.55 per cent of zinc. The average value in recovered metals a ton was $16.41.

Ore, old tailings, etc., sold or treated in Montana in 1929, by counties, with content in terms of recovered metals

DRY GOLD ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaverhead	29	38.78	68	427	1,040	--------
Broadwater	3,074	596.45	394	294	2,166	--------
Deer Lodge	584	549.00	131	778	--------	--------
Jefferson	204	112.69	95	120	--------	--------
Lewis and Clark	[1]52,928	12,271.60	27,539	732	--------	--------
Lincoln	18	8.82	5	--------	--------	--------
Madison	[2]726	779.93	1,226	422	57	--------
Missoula	1	1.00	--------	--------	--------	--------
Phillips	[3]11	57.10	64	31	--------	--------
Powell	92	112.35	38	--------	--------	--------
Silver Bow	9	22.00	188	115	--------	--------
	57,676	14,549.72	29,748	2,919	3,263	--------
Total, 1928	71,102	16,810.30	51,241	1,122	7,219	--------

DRY GOLD AND SILVER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Granite	535	93.00	6,347	--------	--------	--------
Jefferson	129	48.00	2,248	5,548	--------	--------
Lewis and Clark	88	248.00	5,291	445	--------	--------
Madison	95	151.78	3,792	2,719	--------	--------
	847	540.78	17,678	8,712	--------	--------
Total, 1928	207	146.14	4,441	177	--------	--------

DRY SILVER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
Beaverhead	5	--------	1,282	115	--------	--------
Cascade	2	0.50	149	9	71	--------
Deer Lodge	4	2.00	514	--------	--------	--------
Flathead	10,249	43.00	885,511	--------	--------	--------
Granite	[4]30,578	590.00	145,532	17,272	--------	--------
Jefferson	842	222.00	21,604	21,817	102	--------
Silver Bow	2,065	1,026.00	96,513	--------	--------	--------
	43,745	1,883.50	1,151,105	39,213	173	--------
Total, 1928	41,022	1,535.66	285,194	12,424	37,454	--------

[1] Includes 800 tons of old tailings cyanided.
[2] Includes 3 tons of old slag amalgamated.
[3] Includes 1 ton of ashes and mill cleanings sold to a smelter.
[4] Includes 30,000 tons of old tailings concentrated.

Ore, old tailings, etc., sold or treated in Montana in 1929, by counties, with content in terms of recovered metals—Continued

COPPER ORE

County	Ore, old tailings, etc.	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaverhead	51	1.00	495	8,544		
Broadwater	78	2.00	200	9,432		
Cascade	12		5	1,899		
Flathead	24	1.00	17	1,997		
Granite	[5] 3,249	10.00	7,314	210,250		
Jefferson	16	1.00	138	1,637		
Lewis and Clark	28	.10	138	7,271		
Madison	31,776	8,662.00	12,956	119,912		
Meagher	27		6	6,606		
Powell	3		9	660		
Silver Bow	[6] 3,767,712	22,353.84	7,267,729	294,329,371		
	3,802,976	31,030.94	7,289,007	[7] 294,697,579		
Total, 1928	3,174,509	33,546.34	5,705,513	[8] 244,708,989		

LEAD ORE

Beaverhead	[9] 4,508	198.99	43,521	53,618	846,748	
Broadwater	3,132	117.42	43,217	891	2,371,522	
Granite	35	.50	924	65	14,044	
Jefferson	371	102.93	6,067	1,355	143,463	
Judith Basin	165	1.40	1,675	6,373	110,977	
Lewis and Clark	33	6.10	2,074	121	8,518	
Lincoln	74	1.50	980		93,545	
Madison	6,650	341.67	49,190	17,441	1,146,302	
Mineral	25		171	428	14,041	
Missoula	1		28	40	418	
Park	415	10.70	14,739	76	166,749	
Powell	26	4.30	692	33	10,968	
Silver Bow	1		22		468	
	15,436	785.51	163,300	80,441	4,927,763	
Total, 1928	10,419	574.72	178,520	14,989	3,005,336	

LEAD-ZINC ORE

Broadwater	257	35.92	2,572	1,607	39,253	97,525
Cascade	732	2.72	13,495	1,133	60,482	109,156
Granite	23,043	466.82	397,567	88,815	914,934	5,237,025
Jefferson	[10] 20,574	1,363.47	149,910	126,903	1,831,459	2,827,213
Judith Basin	106,586	697.15	782,511	286,928	12,163,984	7,770,524
Lincoln	1,521	52.55	3,923	155	63,093	33,208
Madison	78	3.77	510	1,521	9,854	4,174
Mineral	424	1.15	6,526	497	80,770	145,021
Ravalli	65	6.92	1,823	1,181	5,912	40,456
Silver Bow	166,789	1,294.61	968,656	532,531	9,539,746	28,615,149
	320,069	3,925.08	2,327,493	1,041,271	24,709,487	44,879,451
Total, 1928	764,776	4,303.11	4,108,498	2,487,577	27,112,963	149,607,097

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[5] Includes 2,040 tons of ore leached.

[6] Includes 15,879 tons of old tailings, 13,043 tons of pond slimes, and 1 ton of old slag sold to a smelter.

[7] Includes 6,555,984 pounds of copper recovered from precipitates.

[8] Includes 6,701,580 pounds of copper recovered from precipitates.

[9] Includes 3,372 tons of slag sold to a smelter.

[10] Includes 5,729 tons of old tailings concentrated.

Zinc products (as marketed from Montana mines and mills) sold to smelters and electrolytic plants in 1929

Classification	County	Quantity (dry weight)	Gross zinc	Average assay of concentrates	Recovered zinc
		Short tons	*Pounds*	*Per cent*	*Pounds*
Zinc concentrates	Broadwater, Cascade, Granite, Jefferson, Judith Basin, Lincoln, Ravalli, and Silver Bow.	101,488	114,967,091	56.64	104,264,511
Lead-zinc concentrates.	Cascade, Granite, Jefferson, Lincoln, Madison, Mineral, and Silver Bow.	12,236	14,074,552	57.51	12,854,701
Copper-lead-zinc concentrates.	Silver Bow	300	270,807	45.13	245,595
		114,024	[1]129,312,450	56.70	[1]117,364,807
Total, 1928		150,851	[1]175,504,785	58.17	[1]152,907,933

[1] Exclusive of zinc recovered from the treatment of slag at East Helena.

METALLURGIC INDUSTRY

The general trend toward the adoption of flotation as the chief method of treating Montana ores was continued during 1929. The outstanding new construction work was the completion early in the year of the new 400-ton flotation plant of the St. Joseph Lead Co. near Hughesville. Other construction included the rebuilding and enlargement to 350 tons capacity of the mill of the Montana Mines Corporation near Helena and its conversion from a cyanide plant to an all-flotation plant; the erection of a 100-ton flotation plant near Libby by the Glacier Silver-Lead Mining Co.; and the addition of flotation machinery to and enlargement of the mill of the Liberty Montana Mines Co. at Jefferson Island. A new combined gravity and flotation plant was constructed by the Butte-Madison Mines Corporation near Twin Bridges, a new 75-ton flotation mill was built by the Vigilantes Mining Corporation near Sheridan, and a new gravity mill was erected by the Ardsley Butte Mines Corporation at Butte. The following table lists the important mills that were active in 1929.

Mills in Montana active in 1929

Name of company	Location of mill	Method of treatment	Rated capacity of mill (short tons per day)	Ore and old tailings treated	Concentrates produced
Keating Gold Mining Co.	Radersburg	Gravity	50	Siliceous gold	Siliceous gold.
Silver Dyke Mining Co.	Neihart	Gravity and flotation.	1,000	Copper-lead	Copper-lead.
Granite Bimetallic Consolidated Mines Co.	Philipsburg	Flotation	200	Siliceous silver	Siliceous silver.
Maxville Gold & Silver Mining & Development Co.	Maxville	do	100	Siliceous gold and silver.	Siliceous gold and silver.
St. Joseph Lead Co.	Hughesville	do	400	Lead-zinc	Lead and zinc.
Montana Mines Corporation.	Helena	do	350	Siliceous gold	Siliceous gold.
Glacier Silver-Lead Mining Co.	Libby	do	100	Lead-zinc	Lead and lead-zinc
Liberty Montana Mines Co.	Jefferson Island.	Gravity and flotation.	150	Copper	Copper.
Butte-Madison Mines Corporation.	Twin Bridges	Gravity	90	Lead	Lead.
Vigilantes Mining Corporation.	Sheridan	Gravity and flotation.	75	do	Do.

Mills in Montana active in 1929—Continued

Name of company	Location of mill	Method of treatment	Rated capacity of mill (short tons per day)	Ore and old tailings treated	Concentrates produced
Anaconda Copper Mining Co.:					
Copper concentrator	Anaconda	Flotation	12,000	Copper	Copper.
Zinc concentrator	do	do	1,750	Lead-zinc and zinc.	Lead, lead-zinc, and zinc.
Timber Butte	Butte	do	1,000	Copper-lead-zinc, lead-zinc, and zinc.	Lead, copper-lead-zinc, lead-zinc, and zinc.

Twenty-five milling plants of various kinds were active in Montana in 1929, although many of them ran for short periods only. They include 7 plants using the amalgamation process, 2 using amalgamation and concentration, 3 using cyanidation, 2 using table concentration, 4 using flotation equipment after table concentration, and 7 using straight flotation. There were also 2 electrolytic zinc-leaching plants, 1 copper-precipitating plant at Butte that recovers copper from mine waters, 1 copper-leaching plant, and 1 zinc-fuming plant.

Of the ore, etc., treated at gold and silver mills, 8,257 tons (8,254 tons of ore and 3 tons of slag) was treated by amalgamation, with an average recovery per ton of $4.08 in gold and 0.13 ounce of silver, and 10,938 tons of ore and 800 tons of old tailings were treated by cyanidation, with an average recovery per ton of $5.27 in gold and 1.58 ounces of silver. During the year 280 pounds of quicksilver was used—0.034 pound per ton of ore amalgamated and 0.11 pound per ounce of gold and silver bullion recovered—and 15,664 pounds of cyanide was used in gold and silver mills—0.728 pound per ounce of gold and silver bullion and 1.334 pounds per ton of ore and old tailings treated. The quantity of ore and old tailings treated by these processes in 1929 was only 31 per cent of that in 1928, as the ore from the Spring Hill mine, formerly treated by cyanidation, was treated by flotation during most of 1929, and the output of gold ore from the New Gould property treated by amalgamation decreased considerably. The quantity of gold recovered by cyanidation decreased 56 per cent and that recovered by amalgamation 63 per cent.

Concentrating mills in Montana handled 94 per cent of the total material mined or treated. The resulting concentrates, together with those from gold and silver mills, averaged $85.40 in recovered metals a ton compared with $73.43 in 1928, and the quantity of concentrates produced was 10 per cent more than in 1928. The increase in quantity of copper concentrates was especially marked. The copper concentrates exceeded all others combined in total value of metals recovered.

In 1929, for the first time, exact figures for the metal content of the mill feed were obtained from mills treating Montana ore. These figures are presented in the accompanying tables and are separated by classes of ores treated, methods of concentration, and classes of concentrates produced. The metallurgic recoveries obtained by the use of flotation are also given. Of the total ore concentrated 97.3 per cent was treated by straight flotation, 2.6 per cent by combined gravity and flotation, and only 0.1 per cent by gravity methods without flotation equipment. These figures show conclusively the importance of flotation in the concentration of Montana ores. The average assay content of the ore treated can be calculated from the following tables.

Mine production of metals from gold and silver mills in Montana in 1929, by counties, in terms of recovered metals

County	Ore, old tailings, etc., treated (dry weight)		Recovered in bullion			
			Amalgamation		Cyanidation	
	Ore	Old tailings, etc.	Gold	Silver	Gold	Silver
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Broadwater	9		72.25	19		
Jefferson	50		11.79	5		
Lewis and Clark	18,475	800	1,203.07	938	2,931.72	18,290
Lincoln	18		8.82	5		
Madison	550	[1] 3	261.53	87	59.60	231
Powell	90		71.35	20		
	19,192	803	1,628.81	1,074	2,991.32	18,521
Total, 1928	62,666	1,977	4,397.47	2,868	6,799.10	12,297

County	Concentrates and recovered metal				
	Concentrates produced	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Broadwater	1	4.30	25		
Lewis and Clark	75	209.39	4,773		
Madison	17	12.00	12		57
	93	225.69	4,810		57
Total, 1928	213	1,168.66	22,625	77	1,029

[1] Old slag.

Montana ore and old tailings concentrated in 1929, by classes of ore, etc., methods of concentration, and classes of concentrates [1]

Class of material concentrated and method of concentration	Ore and old tailings concentrated	Gross content of mill feed				
		Gold	Silver	Copper	Lead	Zinc
Ore by:						
Flotation—	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Siliceous gold and silver	535	116.00	7,934			
Copper sulphide	3,634,866	24,489.78	7,510,565	304,248,269		
Copper-lead-zinc sulphide	3,666	28.44	20,681	142,870	198,385	399,466
Lead-zinc sulphide	314,365	6,361.24	2,711,894	1,442,559	28,294,905	53,438,417
Zinc sulphide	330,971	2,021.12	1,803,056	1,828,710	8,220,839	85,558,552
Total by flotation	4,284,403	33,016.58	12,054,130	307,662,408	36,714,129	139,396,435
Gravity and flotation	[2] 115,632	18,842.44	196,354	752,143	1,462,794	
Gravity	[3] 5,000	698.93	9,517	2,563	267,668	
Total by all methods	4,405,035	52,557.95	12,260,001	308,417,114	38,444,591	139,396,435
Old tailings by all methods	[4] 35,729	1,369.76	201,440	77,402	371,024	1,375,464
Grand total	[5] 4,440,764	53,927.71	12,461,441	308,494,516	38,815,615	140,771,899

[1] Figures do not include 93 tons of siliceous gold concentrates from ore first treated by amalgamation containing 225.69 ounces of gold, 4,810 ounces of silver, and 60 pounds of lead.

[2] Includes 33,272 tons of siliceous gold ore, 31,712 tons of copper ore, 48,000 tons of copper-lead ore, and 2,648 tons of lead ore.

[3] Includes 3,000 tons of siliceous gold ore and 2,000 tons of lead ore.

[4] Includes 30,000 tons of siliceous silver old tailings and 5,729 tons of lead-zinc old tailings.

[5] Figures do not include 3,129 tons of siliceous gold ore first treated by amalgamation.

Montana ore and old tailings concentrated in 1929, by classes of ore, etc., methods of concentration, and classes of concentrates—Continued

Class of material concentrated and method of concentration	Concentrates produced		Gross content of concentrates				
	Class	Quantity	Gold	Silver	Copper	Lead	Zinc
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore by:							
Flotation—							
Siliceous gold and silver.	Siliceous gold and silver.	107	93.00	6,347	----------	----------	----------
Copper sulphide	Copper sulphide.	[6]625,587	21,080.80	6,994,505	287,876,338	----------	----------
Copper-lead-zinc sulphide.	Copper-lead sulphide.	175	6.54	9,447	64,292	131,271	----------
	Copper-lead-zinc sulphide.	300	4.52	5,603	50,829	32,713	270,807
	Zinc sulphide	110	3.44	2,811	5,919	3,750	97,221
Total from copper-lead-zinc sulphide.	----------	585	14.50	17,861	121,040	167,734	368,028
Lead-zinc sulphide.	Lead sulphide	18,249	1,667.33	1,223,911	602,794	21,246,342	----------
	Lead-zinc sulphide.	12,236	997.55	281,299	164,149	2,797,940	14,074,552
	Zinc sulphide	30,942	927.42	785,302	398,130	1,665,729	34,044,170
Total from lead-zinc sulphide.	----------	61,427	3,592.30	2,290,512	1,165,073	25,710,011	48,118,722
Zinc sulphide	Copper-lead sulphide.	1,261	32.16	60,841	244,395	911,896	----------
	Lead sulphide	2,596	172.24	416,581	251,800	3,020,402	----------
	Zinc sulphide	69,334	1,143.74	1,090,515	1,034,473	3,193,504	79,558,486
Total from zinc sulphide.	----------	73,191	1,348.14	1,567,937	1,530,668	7,125,802	79,558,486
Total by flotation.	----------	760,897	26,128.74	10,877,162	290,693,119	33,003,547	128,045,236
Gravity and flotation	----------	[7] 6,854	16,204.70	163,179	631,506	1,068,623	----------
Gravity	----------	[8] 1,095	566.46	8,083	2,157	227,518	----------
Total by all methods.	----------	768,846	42,899.90	11,048,424	291,326,782	34,299,688	128,045,236
Old tailings by all methods.	----------	[9] 2,453	906.90	163,874	66,197	313,702	1,267,214
Grand total	----------	771,299	43,806.80	11,212,298	291,392,979	34,613,390	129,312,450

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[6] Copper concentrates made at Anaconda are all classified as flotation product in spite of the fact that 1 section of the copper mill was at times used to make a table concentrate suitable for the manufacture of sulphuric acid or for fluxing purposes.

[7] Includes 2,027 tons siliceous gold, 1,654 tons copper sulphide, 2,829 tons copper-lead sulphide, and 344 tons lead sulphide concentrates.

[8] Includes 599 tons siliceous gold and 496 tons lead sulphide concentrates.

[9] Includes 1,122 tons siliceous silver, 229 tons lead sulphide, and 1,102 tons zinc sulphide concentrates.

Metallurgic results obtained by flotation of Montana ore and by concentration of Montana ore and old tailings in 1929

Material treated	Concentrates produced	Ratio of concentration	Per cent recovered in concentrates				
			Gold	Silver	Copper	Lead	Zinc
Ore by flotation:							
Siliceous gold and silver.	Siliceous gold and silver	5.00 : 1	80.17	80.00	-------	-------	-------
Copper sulphide	Copper sulphide	5.81 : 1	86.08	93.13	94.62	-------	-------
Copper-lead-zinc sulphide.	Copper-lead sulphide	20.95 : 1	23.00	45.68	45.00	66.17	-------
	Copper-lead-zinc sulphide	12.22 : 1	15.89	27.09	35.58	16.49	67.79
	Zinc sulphide	33.33 : 1	12.10	13.59	4.14	1.89	24.34
Total copper-lead-zinc sulphide.	----------	6.27 : 1	50.99	86.36	84.72	84.55	92.13
Lead-zinc sulphide	Lead sulphide	17.23 : 1	26.21	45.13	41.79	75.09	-------
	Lead-zinc sulphide	25.69 : 1	15.68	10.37	11.38	9.89	26.34
	Zinc sulphide	10.16 : 1	14.58	28.96	27.60	5.89	63.71
Total lead-zinc sulphide.	----------	5.12 : 1	56.47	84.46	80.77	90.87	90.05
Zinc sulphide	Copper-lead sulphide	262.47 : 1	1.59	3.37	13.36	11.09	-------
	Lead sulphide	127.49 : 1	8.52	23.10	13.77	36.74	-------
	Zinc sulphide	4.77 : 1	56.59	60.48	56.57	38.85	92.99
Total zinc sulphide	----------	4.52 : 1	66.70	86.95	83.70	86.68	92.99
Total ore by flotation	----------	5.63 : 1	79.14	90.24	94.48	89.89	91.86
Total ore and old tailings by all methods.	----------	5.76 : 1	81.23	89.98	94.46	89.17	91.86

Mine production of metals from concentrating mills in Montana in 1929, by counties, in terms of recovered metals

County	Ore and old tailings treated (dry weight)		Concentrates and recovered metal					
	Ore	Old tailings	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Broadwater	3, 282	--------	727	488. 74	2, 702	2, 364	42, 541	97, 525
Cascade	48, 732	--------	2, 980	81. 92	157, 349	398, 003	985, 154	109, 156
Granite	23, 578	30, 000	6, 986	1, 133. 82	530, 790	106, 087	914, 934	5, 237, 025
Jefferson	14, 845	5, 729	4, 033	1, 363. 47	149, 910	126, 903	1, 831, 459	2, 827, 213
Judith Basin	106, 586	--------	18, 745	697. 15	782, 511	286, 928	12, 163, 984	7, 770, 524
Lewis and Clark	33, 272	--------	2, 027	7, 401. 10	1, 061	690	----------	----------
Lincoln	1, 521	--------	110	52. 55	3, 923	155	63, 093	33, 208
Madison	36, 438	--------	2, 506	8, 841. 93	26, 744	128, 619	316, 516	4, 174
Mineral	424	--------	201	1. 15	6, 526	497	80, 770	145, 021
Ravalli	65	--------	44	6. 92	1, 823	1, 181	5, 912	40, 456
Silver Bow	4, 136, 292	--------	732, 940	23, 738. 05	9, 548, 959	278, 345, 949	16, 478, 107	101, 100, 505
	4, 405, 035	35, 729	771, 299	43, 806. 80	11, 212, 298	279, 397, 376	32, 882, 470	117, 364, 807
Total, 1928	4, 048, 928	41, 285	699, 583	38, 496. 36	10, 273, 213	232, 532, 401	29, 844, 017	152, 907, 933

Gross metal content of Montana concentrates produced in 1929, by classes of concentrates

Class of concentrates	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	3, 948	8, 746. 49	139, 207	19, 395	60	----------
Copper	627, 241	29, 727. 80	7, 007, 385	287, 997, 521	----------	----------
Lead	21, 914	2, 180. 87	1, 673, 416	894, 343	24, 835, 053	----------
Zinc	101, 488	2, 257. 36	1, 896, 056	1, 461, 967	4, 931, 178	114, 967, 091
Copper-lead	4, 265	117. 90	214, 142	804, 775	2, 016, 506	----------
Lead-zinc	12, 236	997. 55	281, 299	164, 149	2, 797, 940	14, 074, 552
Copper-lead-zinc	300	4. 52	5, 603	50, 829	32, 713	270, 807
	771, 392	44, 032. 49	11, 217, 108	291, 392, 979	34, 613, 450	129, 312, 450
Total, 1928	699, 796	39, 665. 02	10, 295, 838	242, 929, 331	33, 653, 053	175, 504, 785

Mine production of metals from Montana concentrates in 1929, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Broadwater	728	493. 04	2, 727	2, 364	42, 541	97, 525
Cascade	2, 980	81. 92	157, 349	398, 003	985, 154	109, 156
Granite	6, 986	1, 133. 82	530, 790	106, 087	914, 934	5, 237, 025
Jefferson	4, 033	1, 363. 47	149, 910	126, 903	1, 831, 459	2, 827, 213
Judith Basin	18, 745	697. 15	782, 511	286, 928	12, 163, 984	7, 770, 524
Lewis and Clark	2, 102	7, 610. 49	5, 834	690	----------	----------
Lincoln	110	52. 55	3, 923	155	63, 093	33, 208
Madison	2, 523	8, 853. 93	26, 756	128, 619	316, 573	4, 174
Mineral	201	1. 15	6, 526	497	80, 770	145, 021
Ravalli	44	6. 92	1, 823	1, 181	5, 912	40, 456
Silver Bow	732, 940	23, 738. 05	9, 548, 959	278, 345, 949	16, 478, 107	101, 100, 505
	771, 392	44, 032. 49	11, 217, 108	279, 397, 376	32, 882, 527	117, 364, 807
Total, 1928	699, 796	39, 665. 02	10, 295, 838	232, 532, 478	29, 845, 046	152, 907, 933

Mine production of metals from Montana concentrates in 1929, in terms of recovered metals—Continued

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous	3,948	8,746.49	139,207	18,244	57	
Copper	627,241	29,727.80	7,007,385	276,474,282		
Lead	21,914	2,180.87	1,673,416	715,337	23,593,303	
Zinc	101,488	2,257.36	1,896,056	1,347,497	4,684,622	104,264,511
Copper-lead	4,265	117.90	214,142	643,819	1,915,681	
Lead-zinc	12,236	997.55	281,299	151,256	2,657,787	12,854,701
Copper-lead-zinc	300	4.52	5,603	46,941	31,077	245,595

Crude ore directly smelted in 1929 averaged $22.16 in recovered metals a ton. An increase of 36 per cent was recorded in the total quantity of ore smelted, especially in copper ore and dry and siliceous ore. The chief product was copper ore, averaging $17.45 in recovered metals a ton.

Gross metal content of Montana crude ore shipped to smelters in 1929, by classes of ore

Class of ore	Quantity (dry weight)	Gross metal content			
		Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous	15,465	3,603.88	1,039,710	34,630	3,558
Copper	105,435	1,077.10	221,382	10,073,769	
Lead	7,391	594.23	142,697	70,940	4,498,088
Copper-lead	59	4.00	528	5,885	50,762
	128,350	5,279.21	1,404,317	10,185,224	4,552,408
Total, 1928	94,383	6,022.78	485,863	8,279,790	3,144,025

Mine production of metals from Montana crude ore shipped to smelters in 1929, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Beaverhead	1,221	238.77	38,134	40,702	502,407
Broadwater	3,250	186.50	43,637	9,860	2,370,400
Cascade	14	.50	154	1,908	71
Deer Lodge	588	551.00	645	778	
Flathead	10,273	44.00	885,528	1,997	
Granite	1,822	26.50	26,894	118,363	14,044
Jefferson	1,512	474.83	30,147	30,477	143,565
Judith Basin	165	1.40	1,675	6,373	110,977
Lewis and Clark	578	783.92	10,375	11,937	54,709
Lincoln	74	1.50	980		93,545
Madison	2,334	764.09	40,600	13,396	839,640
Meagher	27		6	6,606	
Mineral	25		171	428	14,041
Missoula	13	1.60	161	690	2,451
Park	415	10.70	14,739	76	166,749
Phillips	10	53.60	45	31	
Powell	31	45.30	719	693	10,968
Silver Bow	105,998	2,095.00	309,707	9,496,537	468
	128,350	5,279.21	1,404,317	9,740,852	4,324,035
Total, 1928	94,383	6,022.78	485,863	7,917,579	2,986,929

Mine production of metals from Montana crude ore shipped to smelters in 1929, in terms of recovered metals—Continued

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous	15,465	3,603.88	1,039,710	32,600	3,379
Copper	105,435	1,077.10	221,382	9,657,554	
Lead	7,391	594.23	142,697	45,990	4,272,432
Copper-lead	59	4.00	528	4,708	48,224

The miscellaneous material, other than old tailings milled and current slag from the lead smelter fumed at East Helena, consisted of 34,336 tons of old slag, old tailings, and pond slimes shipped for smelting and ore leached. It came chiefly from Silver Bow County and yielded 229.54 ounces of gold, 67,491 ounces of silver, 2,031,761 pounds of copper, and 345,381 pounds of lead; in addition, 6,555,984 pounds of copper was recovered from precipitates.

REVIEW BY COUNTIES AND DISTRICTS

BEAVERHEAD COUNTY

The value of the production of metals in Beaverhead County increased from $78,047 in 1928 to $93,604 in 1929. The output was chiefly lead ore shipped from the Hecla mine and old lead slag from the Hecla dump.

Argenta district.—The production of the Argenta district was valued at $1,772, a decrease from $23,546 in 1928 when the Ferdinand mine near Argenta was active. The output in 1929 consisted of oxidized lead ore from the Iron Mountain and Brownell properties.

Bannack district.—Other than a small placer production, the output from the Bannack district consisted of small lots of sulphide lead ore and rich gold ore from the Gold Bug property.

Blue Wing district.—A small lot of silver ore was shipped from the New Departure property, which was under lease.

Brown's Lake district (*Rock Creek*).—At the Ivanhoe & Franks property near Brown's Lake about 200 feet of tunnel work was done and two cars of sulphide copper ore were shipped for smelting.

Bryant district (*Melrose*).—Lessees continued to operate the Hecla mine near Melrose, and more than 800 tons of oxidized lead ore containing considerable silver and copper was shipped to the lead smelter at Midvale, Utah. No development was done by the lessees, but late in the year the property was sold to the Foundation Co. of Utah, which plans to open the property at greater depth by a lower tunnel. Shipments of lead slag from the old Hecla slag dump, a large producer of lead from 1923 to 1927, were resumed in 1929. Nearly 3,400 tons of this material was shipped to the smelter at East Helena during the year, and as a result the value of the district output was increased to $78,376.

Chinatown district.—The Hamilton mine near Armstead, formerly operated by the Standard Silver Lead Co., was worked by a lessee in 1929, and several cars of sulphide lead ore were shipped to Midvale, Utah, for smelting.

Elkhorn district.—No production was reported from the Elkhorn mine of the Boston-Montana Mines Co. in 1929, but the company reconditioned its narrow-gage railroad between Divide, a station on the Oregon Short Line Railroad, and the mine at Coolidge. Nearly $85,000 was said to have been spent in development, which consisted of more than 2,600 feet of drifts and 200 feet of raises; a large quantity of milling ore was reported to have been developed. The company's 750-ton concentration plant is equipped with a gyratory crusher, ball mills, James tables, and Janney flotation machines. The property was a large producer of copper-lead-silver ore in 1925.

Vipond district.—The Quartz Hill Mining Co. continued to develop the Lone Pine and Argyle Silver claims, 12 miles from Divide, and did 150 feet of sinking and 1,650 feet of drifting and crosscutting.

BROADWATER COUNTY

The value of the production of metals in Broadwater County increased from $138,688 in 1928 to $202,681 in 1929, as a result of the large increase in the shipments of lead ore from the Joe Dandy mine near Radersburg.

Backer district (*Canton*).—Three placers and three lode mines in the Backer district produced 20 tons of ore, $3,138 in gold, 105 ounces of silver, and 2,341 pounds of lead, valued in all at $3,341. The Slim Jim property produced a small quantity of rich gold ore which was treated by amalgamation and gravity concentration. The resulting bullion, valued at about $1,300, was deposited at the Helena assay office, and one lot of gold concentrates was shipped to the smelter at East Helena. Oxidized lead ore from the Satellite property, where a new mill was being constructed, and a little gold ore from the Humming Bird mine were shipped to the smelter at East Helena. Most of the placer output of the Backer district came from the Consolidated Placer (Eldorado Bar) in Confederate Gulch operated by the Diamond City Mines Co. Gold bullion valued at about $800 was recovered from this property, which is worked by sluicing.

Beaver district (*Winston*).—Four lode mines in the Beaver district produced 225 tons of ore, yielding $1,069 in gold, 3,213 ounces of silver, 1,781 pounds of copper, 45,606 pounds of lead, and 65,965 pounds of zinc, valued in all at $10,321, or $45.87 in metals a ton. The East Pacific property, owned by the Montana Mines Corporation, was operated by lessees who hand-sorted the dump and shipped a small lot of sulphide lead ore for smelting and about 80 tons of lead-zinc ore for custom milling at Butte. At the Little Olga & Quartette property, also owned by the Montana Mines Corporation, lessees marketed a small lot of sulphide lead ore and the company continued to drive a 3,400-foot tunnel by advancing the face about 400 feet. The small flotation mill at the property was idle and has been partly dismantled. Lessees also operated the January mine near Winston and shipped several cars of lead-zinc milling ore and a small lot of first-class sulphide lead ore. A car of gold ore was shipped from the Gold Bug mine.

Cedar Plains district (*Radersburg*).—One placer and nine lode mines in the Cedar Plains district produced 6,204 tons of ore, $12,972 in gold, 42,517 ounces of silver, 10,367 pounds of copper, and 2,353,153 pounds of lead, valued in all at $185,708. The ore yielded on the average $29.84 in metals a ton; the placer output was valued at $550.

The ore output, which increased about 80 per cent in value, consisted of 3,176 tons of smelting ore, 3,025 tons of concentrating ore which was reduced to 603 tons of concentrates, and 3 tons of gold ore treated by amalgamation. The Butte Copper Consolidated Mines operated the Joe Dandy property near Radersburg and shipped 3,040 tons of oxidized lead ore containing 16.68 ounces of gold, 41,899 ounces of silver, a little copper, and 2,456,253 pounds of lead. The mine, which ranked fourth as a producer of lead in Montana in 1929, is opened by a vertical shaft 600 feet deep and by about 4,000 feet of drifts and crosscuts. During the year the company deepened its shaft 100 feet to the 600-foot level and did about 2,500 feet of drifting and crosscutting. The main ore body was opened on the 600-foot level, and additional ore bodies were found on the 400, 500, and 600 foot levels. The Montana Exploration Co., operating the Keating mine, treated about 3,000 tons of gold-bearing iron ore in a 40-ton jig concentration plant and shipped about 600 tons of jig concentrates for smelting. New equipment for both the mill and the mine surface plant was installed during the year. One car of lead ore of milling grade and several cars of oxidized copper ore were shipped from the Copper Queen property. Small lots of gold ore were marketed from the Mighty Monarch, Iron Age, and Kahoka properties, and oxidized lead ore was shipped from the Santa Anita and Gopher claims. A small lot of gold ore from the Surprise property was treated by amalgamation.

Park (*Hassel*) *district* (*Townsend*).—The Iron Mask mine near Townsend was operated by lessees who shipped several cars of lead-zinc milling ore to a custom flotation plant at Butte. A small quantity of gold ore from the Mountain View property was shipped for smelting.

CASCADE COUNTY

The value of the production of metals in Cascade County was $225,310, a decrease of $405,396 from the output of 1928. This decrease was the largest in any county in the State and was due chiefly to the large decrease in the output of copper, silver, and lead from the Silver Dyke property near Neihart and to the decrease in the shipments of lead-zinc ore from the Galt and Queen of the Hills mines. The output from Cascade County has decreased gradually since 1926, when 13 mines in the county produced metals valued at $1,209,770; the value in 1929 was the smallest since 1916.

Operations were continuous at the copper refinery, rod and wire mill, and electrolytic zinc plant of the Anaconda Copper Mining Co. at Black Eagle near Great Falls. The process of roasting, leaching, purification, and electrolysis used in treating zinc concentrates in the plants at Great Falls and Anaconda to save slab zinc, zinc dross, and cadmium and to recover gold, silver, copper, and lead in residues was reviewed in an article[5] which gave the flow sheet of each plant. The electrolytic cadmium plant at Great Falls was described in a short article[6] published in February, 1930. The results of operations at the Great Falls and Anaconda plants are given under Silver Bow County, with other notes of the Anaconda Copper Mining Co.

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[5] Wiggin, Albert E., and Caples, R. B., Electrolytic Zinc Practice at Great Falls and Anaconda: Eng. and Min. Jour., vol. 128, Aug. 24, 1929, p. 319.

[6] Mitchell, W. E., Electrolytic Cadmium Plant of Anaconda Copper Mining Co. at Great Falls, Mont.: Trans. Am. Inst. Min. and Met. Eng., February, 1930, p. 239.

Montana district (*Neihart*).—Five lode mines in the Montana district produced 48,746 tons of ore, yielding $1,704 in gold, 157,503 ounces of silver, 399,911 pounds of copper, 985,225 pounds of lead, and 109,156 pounds of zinc, valued in all at $225,310, or $4.62 in metals a ton, a decrease from $630,706 in 1928. The output consisted of 14 tons of smelting ore, and of 48,732 tons of milling ore which was reduced to 2,980 tons of concentrates. The Silver Dyke Mining Co. operated its mine and mill near Neihart until April, when the property was closed as a result of depletion of the ore reserves. The mill treated about 48,000 tons of copper-lead ore and shipped about 2,800 tons of copper-lead concentrates to the smelter at East Helena. This mine has been an important producer of silver, copper, and lead since 1923 and attained a maximum production of nearly 4,000,000 pounds of lead in 1926, since which time the output has decreased steadily. In 1929 the property ranked sixth in the production of copper in Montana, ninth in lead, and tenth in silver. The Galt mine, which produced more than 3,000 tons of lead-zinc ore in 1928, was virtually idle in 1929; only one small shipment of ore was made. The Queen of the Hills mine was operated by lessees who shipped about 700 tons of lead-zinc ore to a custom milling plant at Butte. The crude smelting ore shipped from the Montana district consisted of a small lot of oxidized copper ore from the Provo property and a little silver ore from the Commonwealth mine, where about 250 feet of drifting was done. No output was reported from the property of the Broadwater Consolidated Mines Co., but the company did about 1,000 feet of development in 1929.

DEER LODGE COUNTY

The value of the production of metals in Deer Lodge County increased from $10,248 in 1928 to $11,882 in 1929. Most of the output was iron-gold ore from the Holdfast mine near Southern Cross.

The copper smelting plant, the copper flotation mill, the zinc flotation mill, and the new electrolytic zinc plant of the Anaconda Copper Mining Co. near Anaconda were active throughout 1929. The 12,000-ton copper flotation mill treated as usual ore from the mines at Butte, but no statement of the quantity or tenor of the ore milled was published in the company's annual report. Lead-zinc ore, chiefly from Butte, was milled in the 1,750-ton zinc flotation plant, a separate building east of the copper concentrator. An article[7] describing the work at these mills appeared in August. The copper smelting plant, the only copper smelter operated in Montana in 1929, made blister copper at the rate of nearly 25,000,000 pounds a month. The problems involved in smelting the Butte ores and the development of the practice at Anaconda from small matte furnaces to enormous reverberatories were presented in the Anaconda number[8] of the Engineering and Mining Journal. The electrolytic zinc plant at Anaconda was completed in February, 1928, and operated at capacity in 1929. This plant, with the original one at Great Falls, is also described in the article referred to under Cascade County. The products of these plants are given in the notes of the Anaconda Copper Mining Co. under Butte district, Silver Bow County.

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[7] Morrow, Bayard S., Both Copper and Zinc Ores Treated by Selective Flotation: Eng. and Min. Jour., vol. 128, Aug. 24, 1929, p. 295.

[8] Laist, Frederick, Modern Metallurgical Miracles: Eng. and Min. Jour., Aug. 24, 1929, p. 287.

Dry Gulch district.—A small quantity of bullion was recovered from limited operations at the Dry Gulch placer on Modesty Creek.

Georgetown district (*Southern Cross*).—Three lode mines in the Georgetown district produced 579 tons of ore, yielding $11,246 in gold, 117 ounces of silver, and 778 pounds of copper, valued in all at $11,445, or $19.77 in metals a ton. Most of the output was gold-bearing iron ore from the Holdfast mine. Other producers in the district were the Oro Fino and Southern Cross mines.

Oro Fino district.—A small lot of silver ore from the Cashier property and a small quantity of gold ore from the Independent claims south of Race Track were shipped for smelting.

FERGUS COUNTY

No production was reported from Fergus County in 1929 although the county was formerly a large producer of gold. In 1921 mines in Fergus County produced considerable gold ore and the output was valued at more than $80,000. The production, however, has decreased steadily in recent years, and in 1928 the total value was only $2,968. A little development was done at several properties in 1929; the most notable was about 500 feet of tunneling and drifting done at the Tail Holt mine in the Warm Springs district.

FLATHEAD COUNTY

Hog Heaven district.—The Flathead mine near Kila was operated by lessees during the first half of the year and subsequently by the Anaconda Copper Mining Co. The output consisted of more than 10,000 tons of rich silver ore of smelting grade and represented a marked increase from the few hundred tons shipped in 1928, when the mine became productive. The Ole Mining Co. was organized in 1929 to explore property adjoining the Flathead mine.

Whitefish district.—One car of oxidized copper ore was shipped from the M. C. property, 20 miles northwest of Kalispell.

GRANITE COUNTY

A general increase in the five metals was reported from Granite County in 1929. The value of the metal output increased from $451,877 in 1928 to $781,565 in 1929. The county increase was one of the largest in the State and was due chiefly to the shipping of several thousand tons of lead-zinc ore of milling grade from the Trout mine near Philipsburg. There was also a large production of silver, lead, and zinc from the Silver Prince mine and a large production of silver from the Granite Bimetallic dump. In 1922 the mines of the county produced metals valued at more than $800,000.

Dunkleberg district.—One car of silver ore from the Hydee property was shipped to the smelter at Anaconda.

First Chance district (*Garnet*).—Placer gold was recovered by sluicing operations at the Elfers and Potlatch placers in Deep Gulch near Garnet.

Flint Creek district (*Philipsburg*).—Four lode mines and one tailings dump in the Flint Creek district produced 23,498 tons of ore and 30,000 tons of old tailings, yielding $20,968 in gold, 542,092 ounces of silver, 105,478 pounds of copper, 897,554 pounds of lead, and

5,214,628 pounds of zinc, valued in all at $729,179, or $13.63 in metals a ton. In 1928 seven lode mines and one old tailings dump produced 48,074 tons of ore and old tailings with a total value in metals of $411,981. In 1929 the production was more valuable than that in any year since 1922, and the increase in the value of the district output accounted for most of the Granite County increase. The output of the Flint Creek district consisted of 22,940 tons of milling ore, which, with 30,000 tons of old tailings, was reduced to 6,845 tons of concentrates, and 558 tons of crude ore of smelting grade. The Trout Mining Co., the largest producer in the district, shipped several cars of silver ore to the Washoe sampler and more than 17,000 tons of lead-zinc ore to the Timber Butte mill at Butte. The ore was valuable chiefly for its zinc and silver content and in 1929 the property ranked seventh as a producer of zinc and silver and tenth as a producer of lead in Montana. In addition to the lead-zinc operations the company mined and milled a large quantity of manganese ore and shipped manganese concentrates to eastern manufacturing plants. The Silver Prince Mining Co. continued to operate the Silver Prince property and shipped about 5,000 tons of lead-zinc milling ore to the Timber Butte plant, a decrease from about 7,000 tons in 1928. The property ranked eleventh as a producer of zinc in Montana in 1929. The company also shipped a few cars of silver ore to the smelter at Anaconda. During 1929 development consisted of about 1,700 feet of drifting and crosscutting and about 140 feet of winze-sinking. The Granite Bimetallic Consolidated Mining Co. treated old Granite Bimetallic tailings by flotation and shipped more than 1,000 tons of rich silver concentrates to the smelter at East Helena. The production was slightly more than that in 1928. No output was reported from the Granite Bimetallic mine, although it was an important producer in the past. The Frisco property was operated under lease by the Liberator Mines Corporation, and several cars of lead-zinc ore were shipped to Butte for milling. Lessees operating the True Fissure group also shipped several cars of lead-zinc ore to the custom mill at Butte. In 1929 the Moorlight Mining Co. continued to treat manganese ore from several mines in the district and shipped nearly 4,400 long tons of manganese concentrates east for use in storage batteries. The company treated 10,177 long tons of manganese ore by magnetic concentration and shipped 388 tons without treating. No dividends were reported in 1929. Details regarding the character and treatment of the manganese ores at Philipsburg are given in the general report on manganese.[9]

Frog Pond Basin district.—Lessees operating the Miller claims, 38 miles southwest of Philipsburg, shipped two cars of lead-zinc ore of milling grade to the custom plant at Butte.

Gird Creek district.—A small lot of sulphide lead ore was shipped to the smelter at East Helena from the Blue Bell claims on Gird Creek near Mount Princeton. The ore was loaded at Stone, a station on the Northern Pacific Railway.

Henderson (*Black Pine*) *district.*—Lessees shipped several cars of oxidized copper ore from the Combination (Black Pine) property to the smelter at Anaconda. The ore is hauled 9 miles to Philipsburg, a station on the Northern Pacific Railway.

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[9] Smith, Lewis A., Mineral Resources, 1928, Pt. I, p. 216.

Maxville district.—The Gold Coin Mining Co. operated the Copper State property near Maxville and shipped to Anaconda several hundred tons of first-class oxidized copper ore and some copper precipitates from leaching operations. The company also completed and operated a 75-ton leaching plant consisting of crushing, roasting, leaching, filtration, and scrap-iron precipitation equipment. The new mill was run the latter part of the year and treated several hundred tons of oxidized copper ore. The chief copper minerals in the ore are malachite, azurite, cuprite, and chrysocolla. The company did 1,050 feet of development in 1929. The Maxville Gold & Silver Mining & Development Co. operated the Hoffman mine 1 mile northwest of Maxville and treated more than 500 tons of siliceous gold and silver ore in a 100-ton flotation plant. The resulting concentrates, containing nearly 60 ounces of silver and 0.87 ounce of gold to the ton, were shipped to Anaconda for smelting. The company spent about $10,000 in development and considerable new ore was reported to have been opened.

South Boulder district (*Maxville*).—One car of sulphide lead ore was shipped to the smelter at East Helena from a property near Maxville.

JEFFERSON COUNTY

The value of the production of metals in Jefferson County was $473,077 in 1929 compared with $182,882 in 1928. The quantity of ore and the output of all metals, especially silver, lead, and zinc, increased considerably; this increase was due chiefly to the activity in the shipment of lead-zinc ore from the Comet mine near Basin. There was also a marked increase in the production of zinc from the Comet tailings dump. Lead-zinc ore from the Gray Eagle property of the Basin Montana Tunnel Co. added considerably to the output of the county, particularly in silver, lead, and zinc. The small placer output of the county, from three properties, was valued at $137.

Amazon district.—Two cars of first-class silver-lead ore were shipped from the Wilber Silver property near Amazon.

Bigfoot district.—Lessees shipped more than 600 tons of lead-zinc ore from the Big Four property on State Creek to the custom milling plant at Butte, a decided increase over the output of 1928.

Boulder district.— The Baltimore property 4 miles northwest of Boulder was operated by a lessee who shipped one car of siliceous silver ore and several cars of lead-zinc mill ore. A small test lot of sulphide lead ore was also shipped from the McKinley claim.

Cataract district (*Basin*).—One placer, 8 lode mines, and 1 tailings dump in the Cataract district produced 14,315 tons of ore and 5,729 tons of old tailings, $32,890 in gold, 164,580 ounces of silver, 143,125 pounds of copper, 1,718,719 pounds of lead, and 2,593,437 pounds of zinc, valued in all at $425,247. The ore and old tailings yielded on the average $21.22 in metals a ton. In 1928 10 lode mines and 1 tailings dump produced 5,709 tons of ore and old tailings with a total value of $108,752. The increase of $316,495 in the value of the district output was due to resumption of operations at the Comet mine, increased shipments of old tailings from the Comet dump, and production of lead-zinc ore from the Gray Eagle mine. The district output consisted of 953 tons of first-class smelting ore, 50 tons of siliceous gold ore treated by amalgamation, and 19,041 tons of ore and old tailings of milling grade which was reduced to 3,686 tons of concentrates. The Comet mine near Basin, the largest producer in the district, was operated by lessees who shipped several cars of sulphide lead ore for smelting and more than 12,000 tons of lead-zinc ore of milling grade. The ore was loaded at Fuller, a station on the Great Northern Railway. In 1928 less than 100 tons of ore was shipped from the property. In addition to reopening about 1,000 feet of old workings the lessees did about 200 feet of new development during the year. The mine is opened by a 900-foot vertical shaft and about 15,000 feet of drifts, crosscuts, and raises. Lessees continued to ship old lead-zinc tailings from the Comet dump to the Timber Butte mill, and the production was considerably larger than that in 1928, particularly in the output of zinc. At the Gray Eagle mine, also near Basin, the Basin Montana Tunnel Co. continued the exploration work started in 1928 and shipped several hundred tons of first-class silver ore containing about 2 per cent of copper and several hundred tons of lead-zinc ore of milling grade. The ore is hauled 4 miles by truck to the loading bins at Fuller, a shipping point on the Great Northern Railway. The silver ore was shipped to the copper smelter at Anaconda and the lead-zinc ore was concentrated at the Timber Butte mill. The mine is opened by a main 400-foot tunnel and a vertical winze from the tunnel level to the 600-foot level. During 1929 the company did about 3,000 feet of development, chiefly in drifts and crosscuts. Much new mining equipment, including an electrically-driven compressor and a hoist, was installed during the year. At the Gray Lead property 50 tons of siliceous gold ore was treated by amalgamation, and the resulting bullion was shipped to the assay office at Helena. Lessees continued operations at the Crystal mine and shipped one car of siliceous gold and silver ore to a smelter and several cars of lead-zinc mill ore to the Timber Butte mill. The Creden Mines Corporation continued to operate the Minneapolis claim under lease from the Basin Montana Tunnel Co. and did about 750 feet of development, consisting of drifting and crosscutting. The output from the Minneapolis mine consisted of several cars of siliceous silver ore of smelting grade and several cars of lead-zinc mill ore. Lessees operated the Morning Glory property and shipped several cars of first-class silver ore to the Anaconda smelter. A small lot of sulphide lead ore was shipped from the Red Wing property near Basin, and a test lot of similar ore was shipped from a property near Bernice. No production was reported from the Bullion mine 10 miles north of Basin; the Schmit Bullion Mining Co. was organized during the year to work the property, and about $10,000 was spent for new mining and milling equipment. The Silver Hill Mines (Inc.) was formed during the year to operate a group of claims between the Comet and Gray Eagle mines, and a new tunnel was reported to have opened lead-zinc ore.

Colorado district (*Wickes*).—Six lode mines in the Colorado district produced 1,023 tons of ore, yielding $1,899 in gold, 7,104 ounces of silver, 9,326 pounds of copper, 62,183 pounds of lead, and 130,121 pounds of zinc, valued in all at $19,832, or $19.39 in metals a ton. The output consisted of 136 tons of first-class smelting ore, and 887 tons of milling ore which was reduced to 171 tons of concentrates. The output of the district was valued at $39,709 in 1928 and $372,233 in 1927. The large decrease in the value of the output in recent years was due to curtailment in shipments of lead-zinc ore from the Mount Washington mine. Lessees operated the property in 1929 and shipped more than 800 tons of lead-zinc ore to Butte for milling. A small test lot of oxidized lead ore was shipped from the Buckeye property, and a small lot of first-class sulphide copper ore was shipped from the Chalcopyrite claim. The Minnesota property near Wickes was operated by a lessee who shipped a test lot of siliceous gold ore to Anaconda for smelting. Several cars of first-class gold and silver ore containing about 2 per cent of copper were shipped from the Salvail (Woodshout) property to the smelter at Anaconda. The Knickerbocker Mines Co. was organized to reopen the old Alta and Bertha mines near Corbin, and work in 1929 consisted of unwatering and reconditioning the Bertha shaft.

Elkhorn district.—Lessees operating the Haegan property near Boulder shipped several cars of siliceous gold ore to the smelter at Anaconda. The ore was loaded at Queen Siding, a shipping point on the Northern Pacific Railway. The Elkhorn Silver Mining Co. did about 100 feet of shaft sinking and 150 feet of drifting at the Elkhorn group.

Homestake district.—A little siliceous gold ore was shipped from the Ajax mine near Homestake, and a little placer bullion was recovered from the Ella placer on Homestake Creek.

Little Boulder district.—A small lot of siliceous gold ore was shipped via Queen Siding from the No Mans property.

Lump Gulch district (*Clancey*).—One placer and four lode mines in the Lump Gulch district produced 44 tons of ore, $283 in gold, 1,108 ounces of silver, 156 pounds of copper, 22,403 pounds of lead, and 6,651 pounds of zinc, valued in all at $2,752. The ore yielded on the average $62.09 in metals a ton. From Clancey, a station on the Great Northern Railway, a lessee shipped one car of lead-zinc milling ore from the White Pine property, but the output was considerably less than that in 1928. One car of rich sulphide lead ore was shipped by a lessee from the Frohner property to East Helena for smelting. A small lot of siliceous silver ore was shipped from the Little Nell claim near Clancey and a test lot of gold ore was shipped from the Wendall (Badger) property.

Whitehall district.—Five lode mines in the Whitehall district produced 57 tons of ore, yielding $180 in gold, 634 ounces of silver, and 21,518 pounds of lead, valued in all at $1,874, or $32.88 in metals a ton. In 1928 the output consisted of 221 tons of ore valued at $4,878, most of which came from the Sunny Side (Sunny Corner) property. In 1929 only small lots of lead ore were shipped from the Sunny Side, Carbonate, Midnight, Perhaps, and High Up properties.

JUDITH BASIN COUNTY

The value of the production of metals in Judith Basin County was $1,770,231 in 1929, a marked increase from $72,946 in 1928. The value of the production was larger than that of any other county in the State except Silver Bow. The notable improvement in the output of Judith Basin County was the direct result of the work at the Block P property, where the St. Joseph Lead Co. operated a large flotation mill on lead-zinc ore and became the largest producer of lead in Montana.

Barker district (*Hughesville*).—Five lode mines in the Barker district produced 106,751 tons of ore, yielding $14,440 in gold, 784,186 ounces of silver, 293,301 pounds of copper, 12,274,961 pounds of lead, and 7,770,524 pounds of zinc, valued in all at $1,770,210, or $16.58 in metals a ton, compared with a total value of $72,005 in 1928. The output was almost entirely lead-zinc milling ore treated at the Block P mill and at the Timber Butte mill in Butte; the remainder was oxidized lead ore shipped to East Helena for smelting. The Block P property, formerly the Wright & Edwards mine, has been an important producer since 1915. Early in 1927 the property was sold to the St. Joseph Lead Co., which completely rehabilitated the property in 1927 and 1928. Production during this period was much less than that in the past, but the company did an unusual amount of development and constructed a new flotation mill. Development consisted of sinking the shaft an additional 506 feet to the 1,200-foot level and the necessary drifting and crosscutting to open the vein on the 800, 1,000, and 1,200 foot levels. The mine is opened by a vertical shaft 1,260 feet deep and about 28,000 feet of lateral openings. During 1929 almost 4,300 feet of development was done, including 3,120 feet of drifts and crosscuts and 970 feet of raises. The mill, which has a capacity of 400 tons of ore a day and was erected at a cost of about $200,000, is connected with the mine by a 2-mile aerial tramway. The mill equipment consists of two crushers, rod mills, Dorr classifiers, 16 Fahrenwald and 4 St. Joseph flotation machines, 3 Dorr thickeners, and a Dorco filter. The company operates a privately-owned railway connecting the mill with the Great Northern Railway at Monarch, a distance of 11 miles. A modern camp housing 250 employees was also constructed. Operations at the new mill were begun in November, 1928, and were continuous during 1929. Ore is being mined on the 800, 1,000, and 1,200 foot levels of the mine. Lead concentrates are shipped to East Helena for smelting, and zinc concentrates are sold to the Anaconda Copper Mining Co. In 1929 the Block P property ranked first in the output of lead in Montana, fourth in silver, fifth in zinc, seventh in copper, and ninth in gold. Lessees operating the Emerald mine shipped two cars of lead-zinc ore to Butte for milling. The property is opened by a 700-foot tunnel, and development during 1929 consisted of 300 feet of drifting and raising. One car of oxidized lead ore was shipped by a lessee from the Cape Nome property, where $3,500 was spent in development. Several cars of sulphide lead ore were shipped from the Moulten mine, and a little oxidized lead ore was shipped from the Frenchman & Pocket group. No production was reported by the Monarch Silver-Lead Mining Co., but the company spent about $3,000 in development at the Blankenship property near Hughesville. About 2,000 feet of tunnel work was done at the San Miguel property of the Faith Mining Co., and about 400 feet of drifting was done at the Dr. Kallock claim.

Yogo district.— A little placer bullion was recovered from the Fourth of July claim near Windham.

LEWIS AND CLARK COUNTY

The value of the production of metals in Lewis and Clark County in 1929 was $1,646,466, an increase from $1,131,477 in 1928. An increase was also recorded in the quantity of ore and the output of all metals except silver. The value of the output was larger than that in any county except Silver Bow (Butte district) and Judith Basin. The large increase in output of lead and zinc was due to the treatment of current slag from the East Helena lead plant. The large increase in the production of gold resulting from milling operations at the Spring Hill mine offset the large decrease in gold from the New Gould property.

Bear Gulch district.— A small quantity of rich gold ore was shipped from the Aurora property 4 miles north of Rimini.

Dry Gulch district.—One car of rich gold ore from the San Juan claim 3½ miles south of Helena was shipped for smelting. A little placer gold was recovered by drift mining at the Jim Town and Oro placers in Kingsbury Gulch. No production was reported from the Golden Messenger property, 23 miles northwest of Helena, but the company did about 800 feet of development, chiefly in drifting.

Gould district.—The New Gould Mining Co. operated the Jay Gould mine and 50-ton mill part of the year, and in consequence the output of bullion and concentrates decreased considerably. The mine ranked fifth as a producer of gold in Montana in 1929, and the company did about 1,500 feet of drifting. With completion of the new drain tunnel, which cut the vein at the 1,100-foot level in November, mining in the upper workings was suspended. The 50-ton amalgamation-concentration mill will be moved to the portal of the lower tunnel before active mining is resumed.

Grass Valley district.—A lessee operated the Silver Coin property and shipped one car of rich silver-lead ore.

Greenhorn district.—A little sulphide lead ore from the King Tut mine in Skelley Gulch near Austin was shipped to East Helena for smelting.

Heddleston district.—The Blackfoot Silver-Lead Mining Co. continued development at the Carbonate group on Big Blackfoot River 50 miles northwest of Helena. No ore was shipped from the property, but new machinery was installed and about 300 feet of drifting and 100 feet of shaft sinking was done. The mine is opened by a vertical shaft 400 feet deep.

Helena (*Unionville, Spring Hill*) *district.*—The Montana Mines Corporation (formerly the Montana-Idaho Mines Corporation) continued operations at the Spring Hill mine, 5 miles south of Helena, and nearly doubled its output of gold. The mine ranked second as a producer of gold in Montana in 1929. The 200-ton cyanidation plant was operated the first two months of the year, treating 6,904 tons of ore, and bullion valued at about $30,000 was shipped to the assay office at Helena. The mill was closed March 10 and converted to a combined table and flotation plant using two 7-foot Hardinge ball mills, 2 Dorr classifiers, 2 Minerals Separation Sub-A flotation machines, and 3 Wilfley tables. Milling operations were resumed May 1, 1929, and during the remainder of the year 33,272 tons of ore was treated and about 2,000 tons of rich gold concentrates was shipped to East Helena for smelting. As originally planned, the Wilfley tables were used on the flotation tailings, but with the installation of the second Minerals Separation machine the tables were discarded and the plant operated as a straight flotation mill. At the close of the year the new mill had a flotation capacity of 350 tons a day, but the grinding capacity was limited to 225 tons a day. A new crushing plant having a capacity of 750 tons a day was completed in 1929, and an additional ball mill was ordered in October. The equipment consists of a 24 by 36 inch primary jaw crusher, a 14 by 18 inch secondary jaw crusher, and a Symons cone crusher, breaking the ore to minus 1-inch. Mine development during the year consisted of 350 feet of tunneling, 150 feet of crosscutting, 150 feet of raising, and 2,179 feet of diamond drilling. No estimate of ore reserves was published, but it was reported that much new ore was opened during the year. The chief gold-bearing minerals in the concentrates are pyrrhotite, pyrite, and arsenopyrite. Small lots of gold ore and sulphide copper ore were shipped from prospects near Helena.

Lincoln district.—A little placer bullion was recovered from the Harvey placer in Sauerkraut Gulch 8 miles southwest of Lincoln and from the Bloom property in McClellan Gulch. Both properties were operated by sluicing.

Ottawa district (Marysville).—Ten lode mines and one tailings dump in the Ottawa district produced 5,279 tons of ore and old tailings, yielding $47,886 in gold, 26,285 ounces of silver, 4,529 pounds of copper, and 46,624 pounds of lead, valued in all at $65,631, or $12.43 in metals a ton. The output consisted of 497 tons of first-class smelting ore and 4,782 tons of ore and old tailings treated by amalgamation or cyanidation. The production of gold and silver from the Drumlummon mine was about the same as that in 1928 but was considerably less than the yearly output from 1922 to 1927. The property was operated by the St. Louis Mining & Milling Co. of Montana, which treated 3,873 tons of ore by cyanidation and shipped 134 tons of siliceous gold ore to Anaconda for smelting. Bullion valued at about $37,000 was deposited at the assay office at Helena. No development was done during the year, and most of the material mined was old stope filling. About 800 tons of old tailings from the Drumlummon dump was treated by cyanidation in the Aagaard mill. Lessees operated the old Piegan-Gloster property and shipped about 160 tons of first-class gold ore for smelting. A little gold ore from the Gold Bar property, 1 mile north of Marysville, was treated by cyanidation in the Drumlummon mill, and the operator also shipped a few cars of gold ore for smelting. A small test lot of oxidized lead ore from the M & L property was shipped to East Helena from Silver City, a station on the Great Northern Railway. Several cars of rich gold and silver ore were shipped by lessees from the Honeycomb property 4½ miles southwest of Marysville. A lessee operating the Bell Boy claim west of Marysville shipped a sample lot of rich copper-lead ore to East Helena for smelting. During the year the Metalsmith Mining Co. was formed to operate the Bell Boy, Empire, and Whippoorwill groups, 1 mile west of Marysville. A car of rich copper-lead ore from the Shockapee claim, adjoining the Bell Boy mine, was shipped for smelting.

Seven Mile district.—No production was reported from mines in the Seven Mile district in 1929, but the Helena Silver-Lead Mines did about 300 feet of development on a vein containing steel galena.

Smelter district.—Regular smelting operations were continued at the lead plant of the American Smelting & Refining Co. at East Helena, which treated custom material chiefly from Montana and Idaho. The receipts were largely sulphide lead ore and concentrates from the Coeur d'Alene region, Shoshone County, Idaho, and residues from the zinc plants of the Anaconda Copper Mining Co. at Great Falls and Anaconda, Mont. The smelter is equipped with a crushing and sampling plant, bedding plant, 9 Dwight-Lloyd sintering machines, 5 lead blast furnaces, a baghouse, a Cottrell plant, and various kettles and small furnaces for drossing and casting. No refining is done at East Helena; lead bullion is shipped to Omaha, Nebr., for refining, speiss and matte containing copper are shipped to Tacoma, Wash., and a by-product fume rich in cadmium is shipped to Leadville, Colo., for treatment. According to a statement published in the press the products in 1929 contained 19,152 ounces of gold,7,272,316 ounces of silver, 2,968,428 pounds of copper, and 167,562,000 pounds of lead.

The fuming plant of the Anaconda Copper Mining Co. at East Helena was operated continuously on current slag from the lead smelter. The product is an impure zinc oxide containing lead oxide, which is shipped to Great Falls for treatment in the electrolytic zinc plant. The plant was described in an article[10] published in August, 1929. Results of operations were given in the annual report of the Anaconda Copper Mining Co. for 1928 but not in the report for 1929.

Stemple district.—A little gold ore from the Klondike property was treated by amalgamation and the resulting bullion shipped to the assay office at Helena. The Nakoma Mines Co. spent about $18,000 in development at the Golconda property, held under option, but no ore was found and the option was relinquished late in the year.

Vaughn district (*Rimini*).—Four lode mines in the Vaughn district produced 4,905 tons of ore, yielding $6,299 in gold, 384 ounces of silver, and 1,051 pounds of lead, valued in all at $6,570, or $1.34 in metals a ton. Nearly all the output was low-grade gold ore from the Porphyry Dike property, which was treated by amalgamation. The mine was operated by the Gold Cap Mining Co., and the 300-ton amalgamation plant was reconditioned. A large quantity of low-grade gold ore is said to be in reserve. The Montana Lead (Inc.) continued development of a large group of claims on Red Mountain near Rimini. Only a test lot of lead ore was shipped from the property, but development consisted of 750 feet of drifting on the Bunker Hill claim and several hundred feet of work in the adit, which is 2,917 feet long. Small test lots of sulphide lead ore were also shipped from the Black Bird and Helena properties.

Wolf Creek district.—The production of the Wolf Creek district consisted of one car of first-class sulphide copper ore shipped from the New Era property of the Montana Copper & Zinc Co. The ore contains chiefly chalcopyrite and is hauled 5 miles to Wolf Creek, a station on the Great Northern Railway. The Pentabase Mining Co. was organized to operate property which includes the Honeycomb and Crescent claims. New machinery was installed, and about 150 feet of development was done.

LINCOLN COUNTY

The value of the production of metals in Lincoln County decreased from $25,248 in 1928 to $16,210 in 1929, as a result of the decrease in the output of siliceous gold ore from the Gold Standard and Rose properties. The increase recorded in the production of silver and lead was due to the large output of lead-zinc ore from the Hazel T. mine. The Zonolite Co. produced vermiculite, a variety of mica which is ground and roasted for use as an insulating material and other purposes; further details are given in Mineral Resources in the chapter on Mica.

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[10] Laist, Alexander, Fuming Off Zinc from Lead Slags at East Helena: Eng. and Min. Jour., vol. 128, Aug. 24, 1929, p. 325.

Libby district.—The Midas Gold Mining & Milling Co. operated the Rose mine, 36 miles south of Libby. Development was continued, but only a small quantity of ore was treated during the year. During 1928 the company treated 1,000 tons of gold ore by amalgamation and concentration. A little bullion was marketed early in the year, chiefly from mill clean-up material. In addition to free gold the ore contains galena, cerussite, scheelite, tetrahedrite, and pyrite. The mine is opened by an adit and by various drifts and crosscuts. The Glacier Silver-Lead Mining Co., operating the Hazel T. property, was the largest producer in the Libby district in 1929. About 1,500 tons of low-grade lead-zinc ore was treated in the new flotation mill; the resulting lead concentrates were shipped to East Helena, and lead-zinc concentrates were shipped to the Sullivan zinc plant near Kellogg, Idaho. About 1,200 feet of development was done in 1929, and the capacity of the flotation mill was increased to 300 tons of ore a day. A little development was done at the Gold Standard property by the Golden West Mining Co. and at the Tip Top claims by the Tip Top Mines Co., but no ore was shipped.

Troy or Callahan Creek district.—Lessees worked the Silver King property and shipped several cars of rich sulphide lead ore to East Helena for smelting. About 200 feet of tunneling was done at the property during the year. A lessee operated the Snow Storm property of the Snow Storm Silver-Lead Co. and shipped one car of lead-zinc ore to Butte for milling. A small quantity of bullion was marketed from a placer claim near Troy. The Liberty Metals Co. continued to develop a group of claims 6 miles south of Troy, and did 265 feet of tunneling and drifting and considerable diamond drilling during the year. A little tunneling was done at the Silver Strike property, 5 miles south of Troy, and 200 feet of drifting was done at the Silver Tip property by the Montana Sunrise Mining Co.

Wolf Creek district.—A little placer gold was recovered by sluicing at claims on Wolf Creek.

MADISON COUNTY

The value of the production of metals in Madison County decreased slightly from $347,881 in 1928 to $342,305 in 1929. The increase in the value of the lead output was notable but not sufficient to offset the marked decrease in the value of the gold output. The largest producer in Madison County was as usual the Liberty Montana Mines Co., which operated a mine and mill 15 miles south of Jefferson Island. There was also a large production of silver and lead from the Calvin property near Melrose, operated by the Commonwealth Lead Mining Co.; from the Emma property near Twin Bridges, worked by the Butte-Madison Mines Corporation; and from the Buckeye property of the Vigilantes Mining Corporation. There was a general decrease in the output of gold from the mines at Sheridan and Twin Bridges.

Alder Gulch district (*Virginia City*).—Three placers, two lode mines, and a slag dump in the Alder Gulch district produced 84 tons of ore and 3 tons of slag, $6,701 in gold, 3,640 ounces of silver, and 2,719 pounds of copper, valued in all at $9,120. The ore, exclusive of the old slag, yielded on the average $64.69 in metals a ton and consisted chiefly of two cars of siliceous gold and silver ore of smelting grade from the Bell mine. The placer output, valued in all at about $600, came from three properties in Alder Gulch. The Bell mine 2 miles north of Virginia City was operated by the Ardsley Butte Mines Corporation. Two cars of rich gold and silver ore containing considerable copper were shipped to Anaconda for smelting, and development consisted of about 700 feet of drifting. One small lot of siliceous gold ore was shipped from the Bamboo Chief property 11 miles southeast of Alder, and bullion valued at about $3,000 was recovered by amalgamation from old slag from former placer operations.

Bone Basin district.—A small sample lot of rich gold ore from the Davis property was shipped from Whitehall to Anaconda for smelting.

Lower Hot Springs district (*Norris*).—Four lode mines in the Lower Hot Springs district produced 61 tons of ore, yielding $1,298 in gold, 19 ounces of silver, and 57 pounds of lead, valued in all at $1,312, or $21.51 in metals a ton. The output was chiefly siliceous gold ore from the Birdia property of the Stoker Mining Co., which ran an amalgamation and concentration plant early in the year. Small lots of gold ore were shipped from the Boas and Josephine properties. The Empire Mines Co. worked the Galena property and treated a small lot of gold ore by amalgamation. The mill at the Galena mine was rebuilt into a 100-ton plant using amalgamation and flotation.

McCarthy Mountain district.—Four lode mines in the McCarthy Mountain district produced 147 tons of ore, yielding $2,824 in gold, 9,372 ounces of silver, 431 pounds of copper, and 79,800 pounds of lead, valued in all at $12,922, or $87.90 in metals a ton. The output was chiefly oxidized lead ore from the Polly Jane, Vermont, and Contentment properties and rich gold ore from the Hidden Treasure mine. Lessees continued to operate the Hidden Treasure mine, 9 miles from Glen, and shipped two lots of gold ore containing more than 6 ounces of gold to the ton. About 400 feet of development was done at the Polly Jane property.

Mineral Hill district.—The Liberty Montana Mines Co. continued to operate the Mammoth mine, 16 miles south of Jefferson Island, but the mill was idle nearly four months. The property ranked third as a producer of gold in Montana in 1929, although the output was slightly less than that in 1928. Nearly 32,000 tons of copper ore containing considerable gold was treated in the 150-ton table and flotation mill; the ore yielded 1,654 tons of copper concentrates which were shipped for smelting. The mine is opened by 8,800 feet of tunnel work on 5 levels; 3,000 feet of development, chiefly in drifting, was done in 1929. The capacity of the mill was increased from 100 to 150 tons of ore a day, and much new equipment, including a compressor, hoist, and power plant, was installed. Mining and milling costs were reported to be $2.10 a ton. A small lot of siliceous gold ore was shipped by a lessee of the White Pine property.

Potosi district.—A lessee shipped a small lot of sulphide lead ore from the Granite Mountain property near Pony.

Rabbit district.—One placer and eight lode mines in the Rabbit district produced 3,874 tons of ore, $5,608 in gold, 34,492 ounces of silver, 6,344 pounds of copper, and 974,896 pounds of lead, valued in all at $86,526. The ore yielded on the average $22.27 in metals a ton. The output consisted of 1,874 tons of first-class smelting ore, and 2,000 tons of milling ore which was reduced to 496 tons of concentrates. Most of the smelting ore was oxidized silver-lead ore from the Calvin mine 6 miles east of Melrose, operated by the Commonwealth Lead Mining Co. The ore was shipped to East Helena, Mont., and Midvale, Utah, and contained nearly 20 per cent of lead and 13 ounces of silver to the ton. Development in 1929 consisted of 340 feet of drifting and 145 feet of winze sinking. The Emma mine, 11 miles southwest of Twin Bridges, was acquired by the Butte-Madison Mines Corporation January 1, 1929. The mine was operated about five months and a new 60-ton mill treated 2,000 tons of lead ore which was reduced to 496 tons of table concentrates. In addition to the concentrates the company shipped a small lot of sulphide lead ore of smelting grade. The new mill is equipped with a crusher, rolls, ball mill, 3 James tables, and one 8-cell Minerals Separation flotation machine. About 200 tons of oxidized lead ore was shipped from the Jack Rabbit property, 6½ miles east of Melrose. Small lots of oxidized lead ore were shipped from the Cordell, Sunset, and Parrett properties near Twin Bridges, and small lots of siliceous gold ore were shipped from the Goldstock and Shoemaker properties. A little placer bullion was recovered by sluicing at the National placer in Rochester Gulch.

Ramshorn district.—One car of rich gold ore was shipped from the Goldsmith property, and a car of siliceous gold and silver ore was shipped from the Ellajay group. Both lots were shipped from Sheridan, a station on the Northern Pacific Railway. The placer output of the Ramshorn district was valued at $1,603.

Sheridan district.—One placer and six lode mines in the Sheridan district produced 3,168 tons of ore, $7,441 in gold, 6,433 ounces of silver, 12,219 pounds of copper, 100,374 pounds of lead, and 4,174 pounds of zinc, valued in all at $19,619, compared with a total value of $16,607 in 1928. The ore yielded on the average $5.69 in metals a ton and consisted chiefly of lead ore of milling grade. The chief producer was the Buckeye mine on Mill Creek 2 miles northeast of Sheridan, which was operated by the Vigilantes Mining Corporation. A new 75-ton table and flotation plant was completed in September and operated the remainder of the year, chiefly on dump material. The mill treated 2,648 tons of lead ore, which was reduced to 344 tons of lead concentrates; several cars of lead-zinc milling ore were also shipped to Butte for treatment. Development, which cost more than $11,000, consisted of 300 feet of drifting, 70 feet of shaft sinking, and 130 feet of raising. The new 100-ton amalgamation-concentration mill at the Emma B. property of the Smuggler Mining Co. was completed in September and treated about 400 tons of siliceous gold ore the last quarter of the year. Bullion valued at about $2,000 was sent to Helena, and one lot of table concentrates was shipped to Anaconda for smelting. About 600 feet of development was done at the mine, and the hydroelectric power plant and mine camp were completed.

The mill is equipped with a crusher, ball mill, amalgamation plates, and tables. The Gladstone Mines & Reduction Co. closed the Lake Shore & Gladstone group in September, 1928, and the mill was dismantled in 1929. A little bullion, a clean-up from former operations at the cyanidation plant, was shipped to Helena. The remainder of the output from the Sheridan district consisted of small lots of siliceous gold ore from the Bell, Latest Out, and Nettie properties. Placer bullion valued at about $1,500 was recovered from placer claims on Wisconsin Creek by the Syracuse-Montana Mining Co. The Red Pine Mining Co. continued driving its lower tunnel on the Red Pine group and advanced the face to a point 1,600 feet from the portal. The Broadgauge-Tamarack Mining Co. was organized during the year to develop the Tamarack property, 4 miles from Sheridan.

Silver Star district.—The output from the Silver Star district consisted of 2 cars of rich gold ore from the Edgerton mine; 1 car of oxidized copper ore from the King Fisher property, 2½ miles east of Silver Star; and 2 cars of oxidized copper ore from the Ballaklava property. About 600 feet of tunneling was done at the Strawn group by the Jodie Mining & Development Co.

Summit district (*Virginia City*).—Gold and silver bullion valued at about $900 was shipped as a result of a clean-up from the small cyanidation mill at the Mountain Flower property, 10 miles from Alder.

Tidal Wave district (*Twin Bridges*).—Four lode mines in the Tidal Wave district produced 28 tons of ore, yielding $1,021 in gold, 111 ounces of silver, and 257 pounds of copper, valued in all at $1,125, or $40.18 in metals a ton, a decrease from $10,528 in 1928. Most of the output was siliceous gold ore of smelting grade from the Humming Bird property. A small lot of rich gold ore was shipped from the Gray Eagle property, 9 miles east of Twin Bridges, and a test lot of rich gold ore was shipped from the High Ridge claim. A little rich gold ore from the Last Chance claim, 8 miles north of Sheridan, was amalgamated in a hand mortar and the resulting bullion sent to Helena.

Upper Hot Springs district.—Test lots of rich gold ore were shipped from the Blue Grouse and Eclipse properties near Norris.

Washington district (*Meadow Creek*).—The Montana Lead & Zinc Co. continued development work at the Twin Lakes property near McAllister. The lower tunnel was advanced to 1,100 feet from the portal.

MEAGHER COUNTY

Murray (*Battle Creek*) *district.*—A car of oxidized copper ore of smelting grade was shipped from the Copper Glance property on Battle Creek near White Sulphur Springs.

Musselshell district.—Lessees shipped a small lot of first-class oxidized copper ore from the Capitol Hill property.

MINERAL COUNTY

The value of the production of metals in Mineral County increased from $17,940 in 1928 to $22,978 in 1929, chiefly because of the increase in the shipments of lead-zinc ore from the Iron Mountain property, 4 miles north of Superior.

Cedar Creek district (*Iron Mountain, Quartz*).—Five placers in the Cedar Creek district produced gold and silver valued at $1,804. Placer dust or bullion from the region contains little or no silver and is almost chemically pure. The output in 1929 ranged in fineness from 0.950 to 0.990. The largest producer in the Cedar Creek district was the Stemwinder placer in Snow Shoe Gulch, which was worked by hydraulicking. Other producers were the Eddy placer on Deep Creek, operated by the Higley Mining Co.; the property of the Irene Lu Mines (Inc.) on Windfall Creek; the property of the Ohio Placer Mining Co. in Ohio Gulch; and the Stockholm placer on Quartz Creek.

Iron Mountain district (*Superior, Iron Mountain*).—The Iron Mountain property, 4 miles north of Superior, was worked by lessees who shipped more than 400 tons of lead-zinc ore to Butte for milling. Placer bullion valued at about $1,800 was marketed by the Mines Development Co. of Washington, which worked the Klondyke, Golden Treasure, and Michigan claims on Oregon Creek.

St. Regis district.—A car of sulphide lead ore from the Rock Island property, 6 miles north of Deborgia, was shipped to Kellogg, Idaho, for smelting.

MISSOULA COUNTY

Blackfoot district.—A test lot of oxidized lead ore from a prospect near Bonner was shipped to the smelter at East Helena.

Copper Cliff district.—A test lot of siliceous gold ore was shipped from the Mammoth property near Missoula.

Nine Mile district.—The Golden Snake placer in Dry Gulch, 5 miles northwest of Stark, and placers on Pine and McCormick Creeks, also near Stark, produced bullion valued at about $360.

Potomac district.—No production was reported from the Charcoal mine, 5 miles south of Potomac, but about 400 feet of tunneling was done in 1929.

Wallace district.—A car of oxidized copper-lead ore was shipped from the Missoula property, 2½ miles from Clinton.

PARK COUNTY

The value of the metal production in Park County increased from $88 in 1928 to $18,595 in 1929. Nearly all the output was silver-lead ore of smelting grade from the property of The Irma Mines (Inc.) near Gardiner, which has been inactive since 1924.

New World district (*Cooke*).—The Irma Mines (Inc.) operated the Irma & Republic group near Cooke and shipped more than 400 tons of lead ore to the smelter at East Helena. The company also did 350 feet of development in 1929. A test lot of sulphide lead ore was shipped from the Birthday claim near Cooke. A comprehensive report[11] on the New World district, published in 1930, gives detailed descriptions of the important mines as well as the general geology of the region.

Sheepeater district.—The Jardine Mining Co. was a large producer of gold from 1922 to 1926, but no gold ore was mined or treated from 1926 to 1929. A little ore containing scheelite was mined and concentrated at the property in 1929, but the concentrates were not marketed. The following paragraphs are taken from the annual report of the company for 1929:

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[11] Lovering, T. S., The New World or Cooke City Mining District, Mont.: U. S. Geol. Survey Bull. 811–A, 1930, 87 pp.

> It was not considered advisable to commence operations on a large scale during the year without sufficient capital to develop, equip, and work the property on a basis that would insure the profits to which the company is entitled. But development work was commenced on the first of August and has continued to the present time, and milling of tungsten ore was carried on during the last two months of the year.
>
> In 14 Tunnel a vein not previously worked was drifted on for 170 feet and some gold ore of milling grade was encountered. Tungsten ore of good grade was also encountered in the North drift on this vein and a small amount mined; this will be further developed.
>
> Development work in 11 Tunnel opened a good body of tungsten ore, which has also been found in a stope below the level and development and stoping are now being carried on. The tungsten ore body is larger and more regular than heretofore encountered, and the ore is high grade, but has to be concentrated to a still higher grade to make it more readily salable at better prices. It occurs as scheelite, a tungstate of lime. * * *
>
> The concentrates are roasted to eliminate the small quantities of arsenic and sulphur they contain. Our concentrates average about 72 per cent tungsten acid, and objectionable metals are absent or appear only as traces in the final product. * * *
>
> At the end of the year there was on hand tungsten concentrate of an estimated value of $17,500. * * *
>
> No arsenic was produced by the company in 1929.

PHILLIPS COUNTY

The production of metals in Phillips County was valued at $1,219 in 1929, a decrease from $5,058 in 1928 and $286,803 in 1923. The output consisted of a little material recovered at an old mill and one lot of siliceous gold ore from the Mint & Badger property, formerly known as the Ruby Gulch mine.

Little Rockies district.—The mine and cyanidation plant of the Beaver Creek Mining Co., a large producer of gold ore in 1928, were idle in 1929, but a small clean-up from the Beaver Creek mill was shipped to a smelter. The Ruby Gulch (Mint & Badger) mine, formerly a large producer of gold but virtually idle since 1923, was sampled in 1929, and a test lot of rich gold ore was shipped to East Helena for smelting.

POWELL COUNTY

The production of metals in Powell County was valued at $5,870 in 1929, a decrease of $6,414 from the output of 1928. A decided decrease was recorded in the output of gold from both lode and placer mines near Gold Creek.

Big Blackfoot district.—Placer gold valued at about $1,400 was recovered from the Gold Dust and Blackfoot properties near Ogden Mountain, 6 miles northeast of Helmville.

Blossburg district.—A little gold ore from property on the Northern Pacific tract near Elliston was treated in a small amalgamation mill.

Nigger Hill district (Elliston).—Four lode mines in the Nigger Hill district produced 25 tons of ore, yielding $83 in gold, 672 ounces of silver, and 10,764 pounds of lead, valued in all at $1,119, or $44.76 in metals a ton. The output consisted of small lots of first-class lead ore from the Charter Oak, Newport, Flora, and Hardie claims.

Ontario district.—A test lot of oxidized lead ore was shipped from the Wolverine property near Elliston, and a little placer bullion was recovered by sluicing at the Eddy placer, 12 miles from Elliston.

Pioneer district (*Gold Creek*).—Three placers and three lode mines in the Pioneer district produced 42 tons of ore, $2,799 in gold, and 39 ounces of silver, valued together at $2,820. The ore averaged $52.36 in metals a ton and was all siliceous gold ore. The output was chiefly gold ore treated by amalgamation at the Pioneer and Independence groups. A sample lot of rich gold ore from the Red Bird property was shipped to a smelter. The placer output came from the Pioneer, Oro Fino, and Friday properties and was valued at $621, a decrease from $3,863 in 1928. Late in 1929 the Gold Creek Dredging Co. was organized to operate about 5,500 acres of placer ground, including the Pioneer placer, which is held under lease and option.

Snowshoe district.— A test lot of oxidized copper ore from the Opportunity & Last Chance property near Elliston was shipped to Anaconda for smelting. About $6,000 was spent by the Esmeralda Gold Mining Co. in tunneling at the Etna mine.

Zozell district.— The Blue Eyed Maggie mine was said to have been acquired by the North American Mining & Smelting Co., but no production was reported in 1929. About 250 feet of drifting was done at the Bonanza property by the Bonanza Mining Corporation.

RAVALLI COUNTY

Curlew district.— The mill at the Curlew property near Victor was idle in 1929, as it has been since 1926, but two cars of lead-zinc ore were shipped to Butte for milling.

Stevensville district.—A little placer gold from claims near Stevensville was sent to the assay office at Helena.

SANDERS COUNTY

Burns district.—About 300 feet of development, mostly drifting, was done by the Princess Gold Mining Co. at the Iron Daisy property near Thompson Falls. A large quantity of silver-lead ore was said to have been blocked out, and the company is planning to erect a small concentration plant.

Thompson River district.—Development of the Copper Mask property near Thompson Falls was continuous in 1929, and nearly 800 feet of drifting and raising was done.

Trout Creek district.—The only production from Sanders County in 1929 was a small quantity of placer gold from the Vermillion property on Trout Creek.

SILVER BOW COUNTY

Thirty-three mines in Silver Bow County were productive in 1929, but most of the metal output resulted from the operations of four companies at Butte. Although nearly all the large producing mines at Butte were active throughout the year the output of all metals except silver and copper decreased considerably, especially lead and zinc. The value of the silver output, however, was $300,000 less than that in 1928, as the average price of the metal decreased from 58.5 cents an ounce in 1928 to 53.3 cents in 1929. The output of copper increased nearly 50,000,000 pounds on account of the increase in the market price of the metal. The larger part of the ore and old tailings mined or treated was concentrated at custom milling plants at Butte and Anaconda; the resulting products consisted of copper concentrates, lead concentrates, zinc concentrates, lead-zinc concentrates, copper-lead concentrates, and copper-lead-zinc concentrates. These concentrates yielded metals valued at $62,279,945, or $84.97 a ton of concentrates. The crude smelting ore yielded on the average $17.73 in metals a ton. No ore was treated by amalgamation or cyanidation. Old copper tailings, slag, and slime-pond material, amounting to 28,923 tons, were smelted. Of the total output of ore, old tailings, etc., in the county 88 per cent was classified as copper material.

Production of gold, silver, copper, lead, and zinc in Silver Bow County, Mont., 1928 and 1929, in terms of recovered metals

Year	Mines producing	Ore, old tailings, etc.	Gold (lode and placer)	Silver (lode and placer)	Copper[1]	Lead	Zinc	Total value
		Short tons		*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
1928	43	3,896,048	$596,781	9,558,619	247,066,962	24,660,285	147,896,033	$52,218,170
1929	33	4,271,213	538,688	9,918,906	296,316,277	16,478,575	101,100,505	65,687,913

[1] Includes copper recovered from precipitates, as follows: 1928, 6,701,580 pounds; 1929, 6,464,032 pounds.

Butte or Summit Valley district.—Thirty-one lode mines in the Butte or Summit Valley district produced 4,271,207 tons of ore, old tailings, etc., yielding $538,419 in gold, 9,918,841 ounces of silver, 296,316,277 pounds of copper (including 6,464,032 pounds from precipitates), 16,478,575 pounds of lead, and 101,100,505 pounds of zinc, valued in all at $65,687,609, an increase from $52,216,865 in 1928. An unusually large decrease was recorded in the production of lead and zinc from the chief producers at Butte. Excluding the value of the copper recovered from precipitates, the ore, old tailings, etc., yielded on the average $15.11 in metals a ton. In 1929 the ore output consisted of 105,992 tons of first-class smelting ore, 28,923 tons of old tailings, pond slimes, and slag smelted, and 4,136,292 tons of concentrating ore which was reduced to 732,940 tons of concentrates. The mines at Butte have been productive for nearly a half century, and rich copper ore is still being mined at great depth.

From the beginning of activities in 1882 to the end of 1929 Silver Bow County, which includes the Butte district, has yielded gold, silver, copper, lead, and zinc, valued at $2,119,410,164, as follows: Gold, $36,812,395; silver, $325,903,938; copper, $1,530,004,396; lead, $20,762,080; and zinc, $205,927,355. These values represent 1,780,799.56 ounces of gold, 451,567,441 ounces of silver, 9,907,137,449 pounds of copper, 309,209,002 pounds of lead, and 2,539,427,953 pounds of zinc.

According to the printed annual report for 1929 the mines of the Anaconda Copper Mining Co. continued to produce copper ore and precipitates and zinc ore, but the quantity of each was not published. In 1928 the company produced 3,013,495 tons of copper material and 18,159 tons of zinc material, a total of 3,031,654 tons. Every effort was made in 1929 to take advantage of the unusually high price of copper. In February the Mountain View mine was reopened; in July the Anaconda, Mountain Con, and West Colusa mines, which had been closed for repairs, were again operated. In fact, it was stated that for the first six months of 1929 Butte had its maximum copper production and pay roll, and the Anaconda Copper Mining Co. owns or controls all the large copper mines at Butte except the East Butte and North Butte mines. The concentrators at Anaconda and Butte treated considerably more copper ore but less zinc ore. The Anaconda works produced 297,014,107 pounds of fine copper, 8,564,609 ounces of silver, and 33,077.04 ounces of gold, and the greater part of this output came from the copper mines of the Anaconda Copper Mining Co. at Butte. A large quantity of silver and copper was recovered by the treatment at Anaconda of old tailings and slimes from ponds near the smelter. The company was as usual the largest producer of gold, silver, and copper in Montana and ranked third in the production of zinc and fifth in lead.

The company owns a large area at Butte and works other property, such as the Emma mine, under lease; it obtained control of the Anselmo mine in 1926 and purchased all the Clark interests, including the Elm Orlu, Poser, and Moulton, and other property at Butte in 1928. A general description of the geology, mining methods, underground workings, and reduction works is given in The Mines Handbook,[12] and the mining, milling, smelting, and refining methods were reviewed[13] in August, 1929.

The electrolytic copper refinery and the rod and wire mill at Great Falls were active throughout 1929, but details of operations were not published in the company's annual report.

Zinc concentrates and lead-zinc concentrates were received at Anaconda and Great Falls from the mills at Butte and Anaconda and from plants in Utah, Idaho, and Montana. The electrolytic zinc plants at Anaconda and Great Falls produced 273,357,416 pounds of slab zinc. In addition, metals in dross and residue produced amounted to 13,854,061 pounds of zinc, 26,913,502 pounds of lead, 2,921,526 pounds of copper, 3,585,368 ounces of silver, and 8,702.02 ounces of gold. Of this amount 2,404,051 pounds of copper, 290,463 ounces of silver, and 139.95 ounces of gold were treated through the operations of the copper plant. Dividends amounting to $43,590,634 were paid in 1929 by the Anaconda Copper Mining Co., and the net income for the year was $70,317,739, which, added to the balance at the end of the year 1928, gives a surplus of $112,033,553 after deduction of dividends. The company's annual report says:

> Miscellaneous mining claims and lands were acquired at a cost of $978,985. Construction expenditures during the year included $1,059,488 for the Butte Mines, $232,852 for the Reduction Works at Anaconda, and $54,409 for the Reduction Works at Great Falls.

As in the past the company also did a large business in lumber, coal, fertilizer, arsenic, and sulphuric acid in Montana; in manufacturing and refining in the East; in mining, milling, and smelting in Utah, Arizona, California, and Colorado; and in mining and milling in South America and Europe. The present methods of mining, hauling, hoisting, ventilating, and other important phases of operation at the Butte mines are described in an article[14] by the manager of the mines. The large new hoists at the Belmont, Mountain Con, and Badger State shafts, which were described in detail in the mining press, were in successful operation in 1929, and two of them raised ore from a depth of 3,400 feet. They are designed to operate to a depth of 5,000 feet.

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[12] Neale, W. G., The Mines Handbook: Vol. 17, 1926, pp. 77–98.
[13] Anaconda Number, Eng. and Min. Jour., vol. 128, Aug. 24, 1929, pp. 275–340.

The Emma mine of the Butte Copper & Zinc Co. continued to be operated by the Anaconda Copper Mining Co.; its production, however, was considerably less in 1929 than it was in 1928. The chief output of the mine was lead-zinc ore, which was shipped to the Anaconda and Timber Butte plants for milling. Although the ore contains much lead, comparatively little lead concentrates are made, but zinc concentrates and lead-zinc concentrates are made at Butte and Anaconda for treatment in the electrolytic plants at Great Falls or Anaconda. The property ranked second as a producer of lead and zinc and fifth as a producer of silver in Montana in 1929. The Anaconda company also sold 54,521 long tons of manganese ore from the Emma mine. Practically all of this ore was sold to the nodulizing plant at Butte, but a little was shipped to consumers. It was sold for $96,028. From 161,941 tons of lead-zinc ore and manganese ore the Butte Copper & Zinc Co. received $232,013; it received $215,375 in 1928. After other income amounting to $31,857 was added, the total income for 1929 was $263,870. The net income for the year was $203,053, which, added to the surplus of December 31, 1928, gives a total of $864,620. The company paid a dividend in 1929 amounting to $300,000, which left a surplus of $564,620 on December 31, 1929. The following paragraphs are taken from the printed report of the Butte Copper & Zinc Co. for 1929:

> There are large reserves of high grade manganese ores in our properties, and in addition, the engineers report a large tonnage of lower grade ores which can, by beneficiation processes, be converted into a high grade product.
>
> There are now being shipped steadily 250 tons of manganese ores per day. We trust that the 1930 shipments of manganese ores will exceed those of this year. Developments in the mine have been most satisfactory and the lower levels continue to show high grade bodies of good width of both zinc, lead, silver and manganese ores.
>
> During 1929 some new developments have been made on veins which have a northwestern-southeastern direction. These veins carrying pay ore were shown on the 400, 800, 1,100, 1,200, and 1,300 levels. The vein on the 1,200 has been developed for the greatest length, being over 400 feet on ore. These developments are of importance and further mining operations will be prosecuted on them to prove their extent.
>
> Crosscutting is still in progress on the 1,600 level, the deepest level in the Emma Mine, and it is expected that the vein may be cut at any time.

The Black Rock property of the Butte & Superior Mining Co. was worked throughout the year and produced 225,689 tons of zinc ore and 5,225 tons of copper ore, which was treated in the flotation plants at Anaconda. A decided decrease was recorded in the output of zinc ore, and the output of copper ore was less than half that of 1928. The property, however, was again the largest zinc producer in Montana and supplied nearly 37 per cent of the total zinc output of the State. Unfortunately the ore reserves are small and the zinc output was 10 per cent less than that in 1928. The property ranked second in the production of silver, third in lead, fourth in copper, and sixth in gold. During the year the company paid dividends amounting to

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[14] Daly, William B., Evolution of Mining Practice at Butte: Eng. and Min. Jour., vol. 128, Aug. 24, 1929, p. 280.

$580,395, or a total of $20,277,531 to date. As a result of ore sales the company received $2,115,632, compared with $2,117,876 in 1928. The cost of mining, development, and general expense was $2,133,917, leaving an operating loss of $18,285, compared with an operating profit of $52,913 in 1928. After other income of $41,329 was added and $29,027 for accrued taxes deducted, the net loss, without deduction for depletion, was $5,983, compared with a net income of $81,453 in 1928. The following paragraphs are taken from the company's printed report for 1929.

Development work consisted of 22,879 feet of drifts and crosscuts and 4,554 feet of raises, or a total of 27,433 feet.

The program looking to recovery of additional salvage ore in the Rainbow and other veins in the old upper workings of the mine was continued during the year. A total of 167,990 tons of such ore was made available above the 1,600 level, which, together with the development of 112,914 tons of new ore below this level, gave a total increase in available zinc ore reserves for the year of 280,904 tons.

During the entire year an extensive campaign of exploration work was continued for the purpose of exercising all possibilities of developing additional commercial ore in the property. * * *

The estimated zinc ore reserves as of December 31, 1929, follow: 183,048 tons of commercial zinc ore, averaging 5.55 ounces of silver to the ton and 14.77 per cent of zinc.

In addition to the above, there are 141,405 tons of low grade zinc ore and 25,765 tons of low grade copper ore, which are unprofitable to mine at present or any expected metal prices.

The foregoing statement of commercial zinc ore reserves does not include 129,360 tons remaining in the old upper level ore bodies at the end of the year. These cannot be developed sufficiently to permit accurate measurement, except as they are mined, but it is believed that at least double this tonnage may eventually be available.

The total zinc ore produced during the year amounted to 225,689 dry tons containing a total of 1,994 ounces of gold, 1,434,772 ounces of silver, 937,647 pounds of copper, 5,864,195 pounds of lead, and 59,541,660 pounds of zinc, or an average assay of 0.0088 ounce of gold, 6.36 ounces of silver, 0.21 per cent of copper, 1.30 per cent of lead, and 13.19 per cent of zinc. * * *

The production of copper ore amounted to 5,225 dry tons, containing a total of 22 ounces of gold, 25,822 ounces of silver, 328,248 pounds of copper, 28,200 pounds of lead, and 264,985 pounds of zinc, or an average assay of 0.0043 ounce of gold, 4.94 ounces of silver, 3.14 per cent of copper, 0.27 per cent of lead, and 2.54 per cent of zinc.

The Pittsmont mine of the East Butte Copper Mining Co., east of Butte, was worked the entire year and was a large producer of both silver and copper, but its output was considerably less than that in 1928. The output consisted of two grades of copper ore shipped to Anaconda, one for direct smelting and the other for milling. Both the smelter and mill of the East Butte Copper Mining Co. at Pittsmont have been idle since August, 1924. The property is opened by three vertical shafts, the deepest 2,640 feet, and development in 1929 consisted of 7,987 feet of drifts, crosscuts, raises, and winzes. The ore, all sulphide, contains chalcocite, enargite, pyrite, and quartz. The company paid a dividend in 1929 amounting to $106,222, the only one paid since 1919, which makes a total of $1,782,592 paid to the end of 1929. From the Pittsmont property the company mined 96,569 dry tons of copper ore, averaging 4.17 per cent of copper and 4.13 ounces of silver to the ton. The metal content for which payment was made was reported as 345,831 ounces of silver and 6,984,238 pounds of copper, but no statement was published giving the results after milling and smelting the ore at Anaconda. The company also shipped 30 tons of copper precipitates, averaging 69.09 per cent of copper, or 39,888 pounds for which payment was made. The ore output in 1929 included a large quantity of mill ore mined from property leased from the Anaconda Copper Mining Co. In 1929 the Pittsmont mine ranked second as a producer of copper and sixth as a producer of silver in Montana. The gross value of the ores shipped in 1929 was $863,293 and $7,049 was received from a smelter clean-up, making the total returns $870,342. The operating cost was $804,661, leaving a net profit of $65,681. The company also received $45,915 from the shipment of lime rock; other income amounted to $63,294, which makes a total income of $109,209. The company, which also owns property in Colorado and Nevada, gave the following paragraphs regarding the Pittsmont mine at Butte in its annual printed report for 1929:

> As in the previous year, the company's activities were confined principally to Pittsmont mine operations at Butte, and lime quarry operations at Lime Spur, Montana.
>
> The Pittsmont mine was operated throughout the year with very little interruption except that production and development work were hampered during the summer and fall months by a scarcity of experienced miners.
>
> Ore shipments to the Anaconda company's smelter at Anaconda totaled 96,569 tons averaging 4.17 per cent of copper and 4.13 ounces of silver compared with 110,997 tons averaging 4.41 per cent of copper and 4.04 ounces of silver in 1928. Of the total tonnage produced in 1929, 72 per cent was mined in Pittsmont ground and 28 per cent in leased territory.
>
> The small production, heavy development expenditures, royalty on ores obtained from leased ground, difficulties consequent upon an unsatisfactory labor situation during a period of several months, were serious contributing factors towards the high cost per pound of copper paid for.
>
> The sum of $189,997 was expended in exploring and developing the property, this amount being nearly 24 per cent of the total cost of mining. * * *
>
> The most important development work of the year was prosecuted on the new 2,600 level, and while progress was slow, results to date have been more encouraging than they were on the 2,400 level. * * *
>
> At the present rate of production it is estimated that ore reserves will be depleted in a few months unless additional tonnage is developed by development work now under way and other development work which has been planned for the near future.

The Elm Orlu mine, an important producer of the five metals since 1914, was purchased from the Clark interests in 1928 and operated by the Anaconda Copper Mining Co. in 1929. The production for the year was included in the output of the Anaconda Copper Mining Co.

The North Butte Mining Co. operated its Granite Mountain and Main Range properties after 22 months of inactivity. Operations at the Main Range mine consisted entirely of development work. In 1929 the Granite Mountain mine produced 61,800 tons of copper ore and zinc ore which contained 336.11 ounces of gold, 171,537 ounces of silver, 3,525,820 pounds of copper, 122,795 pounds of lead, and 2,703,478 pounds of zinc. The entire output was treated in the flotation plants of the Anaconda Copper Mining Co. at Timber Butte and Anaconda. The property ranked third in the production of copper in Montana in 1929, eighth in zinc, and ninth in silver. The gross returns for ore shipped in 1929 were $418,732, and the deficit for the year was $59,108. The following notes are taken from the company's report for the fiscal year ended March 31, 1930.

During the past year ending March 31, 1930, operations have been carried on continuously at your Granite Mountain and Main Range properties. * * *

At the Granite Mountain mine production of ore has not only been maintained throughout the year but has steadily increased from a few tons per day early in April, 1929, to over 10,000 tons for the month of March, 1930. A vast amount of necessary repair work has also been done in the Granite Mountain as well as a substantial amount of new development work. Substantial replacements and additions have also been made to underground equipment and two substantial structures have been added to your surface plant and a new heating plant under construction has been completed. * * *

After a suspension of operations the first shipment of copper ore was made from the Granite Mountain mine on April 11, 1929. * * * The total copper ore produced during the year ending March 31, 1930, amounted to 77,294 tons and during the same period there were produced 11,056 tons of zinc ore or a total ore tonnage of 88,350 tons having a net value of $604,630. The metal contents of the ores produced during this period were as follows: Copper, 5,464,573 pounds; zinc, 2,703,478 pounds; lead, 122,795 pounds; and silver, 243,095 ounces.

Copper production came from the 600, 800, 1,000, 1,800, 2,000, 2,200, 2,400, 2,600, and 2,800 levels prior to January 1, 1930, and during the past three months production has also come from the 3,200 and 3,400 levels. * * *

Development and repair work have been carried on with the expectation of attaining a production of copper ore of 15,000 tons per month by May, 1930. * * *

Zinc production was resumed in July, 1929, with zinc selling at 6.766 cents per pound, and was continued until January 1, 1930. * * *

Extensive repair work has been done on 13 levels from the 600 to the 3,400 level. * * *

Development work for the year amounted to 9,305 feet of which there was 2,230 feet of drifting, 2,010 feet of crosscutting, 1,661 feet of intermediate drifting, 406 feet of intermediate crosscutting, 1,518 feet of raising, 169 feet of winze sinking, and 1,311 feet of lateral drifting. * * *

Upon resumption of operations at the Main Range mine in March, 1929, the workings below a depth of 1,450 feet measured from the collar of the shaft were under water. All workings to below the 2,200 or bottom level of the mine were completely unwatered by May 15, 1929, and the repair of the shaft and stations was then started. * * *

The Poser mine, controlled by the Anaconda Copper Mining Co. since the transfer of the Clark interests in 1928, was operated by the Moulton Mining Co., which shipped nearly 37,000 tons of lead-zinc ore to the Timber Butte mill for treatment by flotation. Although the output was less than half that in 1928 the mine ranked sixth as a producer of zinc, seventh as a producer of lead, and eleventh as a producer of silver in Montana in 1929. Part of the Otisco mine, owned by the Anaconda Copper Mining Co., was leased by the Southern Development Co., which shipped about 700 tons of mill ore to the Timber Butte custom plant. Development in the southwest section of the Butte area was continued in 1929 and the Ardsley Butte Mines Corporation worked its property most of the year. The company shipped more than 8,000 tons of lead-zinc ore to the Timber Butte mill and several cars of first-class siliceous silver ore to Anaconda for smelting. Although the milling ore contains lead and zinc it is chiefly valuable for its silver content, and in 1929 the property ranked eighth as a producer of silver in Montana. The mine is opened by a vertical shaft 500 feet deep and by drifts on three levels; the company spent $38,099 for development in 1929, chiefly in running 2,000 feet of drifts. Results, however, were not encouraging and the mine was allowed to fill with water early in 1930. The Goldstream mine of the Ardsley Butte Extension Mining Co., adjoining the property of the Ardsley Butte Mines Corporation, produced 7,641 tons of lead-zinc ore containing 214.78 ounces of gold, 137,475 ounces of silver, 12,550 pounds of copper, 64,290 pounds of lead, and 118,969 pounds of zinc. The ore contained galena, sphalerite, tetrahedrite, and chalcopyrite and was shipped to Butte for milling. In 1929, 500 feet of drifting and crosscutting was done and the 2-compartment shaft was sunk an additional 100 feet; the mine was closed in September.

The Magnolia and Curry mines, owned by the Anaconda Copper Mining Co., were worked by lessees, and 5,624 tons of silver-lead-zinc ore was shipped to the flotation plant of the Timber Butte Milling Co. The Eveline mine was operated by a lessee who shipped more than 1,500 tons of first-class siliceous silver ore to Anaconda for smelting and two cars of lead-zinc ore to Butte for milling. The Lizzie mine produced about 2,400 tons of first-class copper ore, which was smelted at Anaconda, as well as 2,600 tons of copper-lead-zinc ore, which was shipped to Butte for milling. The mine was a fairly large producer of silver, copper, lead, and zinc. The Silver Bow mine, owned by the Anaconda Copper Mining Co., was worked by a lessee who shipped more than 6,500 tons of first-class copper ore to Anaconda for smelting; the ore contained nearly 1,000,000 pounds of copper, and the mine ranked fifth as a producer of copper in Montana in 1929. The Blue Bird Consolidated Mining Co. spent $20,000 in development and shipped nearly 400 tons of lead-zinc ore of milling grade. The Lavena mine, 4 miles west of Butte, was worked by the Butte Homestake Mining Co., and about 250 tons of siliceous silver ore was marketed. About 300 tons of mill ore was mined from the Magna Charta property, and shipments were made from the Olive Branch, Moulton, Pacific, Right Bower, Rose O'Malley, and West Olive Branch mines.

The custom flotation mill at Timber Butte south of Butte was active throughout the year, even after it was sold to the Anaconda Copper Mining Co. in August, 1928. The ore supply came chiefly from the Butte & Superior, Emma, Poser, Trout, Comet, and North Butte properties but included much custom material from mines in various counties, especially Silver Bow, Jefferson, Granite, and Cascade. The plant treated nearly 282,000 tons of ore and old tailings in 1929 and made two grades of concentrates—a high-grade silver-lead product for smelting and a high-grade zinc product for treatment by roasting and electrolysis.

Divide Creek district.—Small lots of rich gold ore from the Alice and Lincoln properties near Melrose were shipped to Anaconda for smelting.

GOLD AND SILVER [1]

(GENERAL REPORT)

By J. P. DUNLOP

DOMESTIC PRODUCTION

Approximate distribution of gold and silver produced in the United States in 1929, by producing States

[Figures supplied by the U. S. Bureau of the Mint]

State	Gold		Silver		Increase or decrease from 1928		
	Fine ounces	Value [1]	Fine ounces	Value [2]	Gold	Silver	
						Fine ounces	Value
Alabama	10	$200	------	------	+$200	------	------
Alaska	374, 669	7, 745, 100	478, 973	$255, 293	+910, 900	−7, 886	−$29, 519
Arizona	211, 108	4, 364, 000	7, 840, 321	4, 178, 891	+446, 300	+1, 275, 388	+338, 405
California	409, 020	8, 455, 200	1, 194, 651	636, 749	−2, 154, 600	−272, 437	−221, 497
Colorado	220, 285	4, 553, 700	4, 415, 838	2, 353, 642	−791, 300	+31, 766	−211, 040
Georgia	58	1, 200	13	7	+500	+8	+4
Idaho	19, 597	405, 100	9, 533, 327	5, 081, 263	−15, 600	+583, 611	−154, 321
Illinois	------	------	4, 146	2, 210	------	+1, 469	+644
Michigan	------	------	17, 899	9, 540	------	−808	−1, 404
Missouri	------	------	146, 638	78, 158	------	−11, 642	−14, 436
Montana	55, 854	1, 154, 600	12, 613, 580	6, 723, 038	−78, 700	+1, 931, 905	+474, 258
Nevada	158, 941	3, 285, 600	4, 746, 750	2, 530, 018	−388, 400	−565, 860	−577, 859
New Mexico	33, 026	682, 700	1, 060, 494	565, 243	−40, 000	+135, 045	+23, 855
North Carolina	174	3, 600	14, 414	7, 683	+900	−4, 727	−3, 514
Oregon	17, 657	365, 000	37, 840	20, 169	+119, 700	+5, 982	+1, 532
Pennsylvania	745	15, 400	5, 616	2, 993	−5, 000	−1, 812	−1, 352
Philippine Islands	151, 757	3, 137, 100	94, 547	50, 394	+1, 307, 000	+58, 044	+29, 040
South Carolina	------	------	------	------	−200	------	------
South Dakota	312, 328	6, 456, 400	84, 465	45, 020	−119, 200	−7, 232	−8, 623
Tennessee	653	13, 500	96, 146	51, 246	+2, 400	+20, 239	+6, 840
Texas	1, 263	26, 100	1, 042, 273	555, 531	+14, 600	−352, 392	−260, 348
Utah	237, 221	4, 903, 800	17, 844, 657	9, 511, 202	+533, 400	+95, 340	−872, 148
Vermont	------	------	3, 633	1, 936	------	+3, 633	+1, 936
Washington	3, 972	82, 100	51, 639	27, 524	−257, 200	−52, 268	−33, 262
Wyoming	48	1, 000	8	4	+300	−5	−4
	2, 208, 386	45, 651, 400	61, 327, 868	32, 687, 754	−514, 000	+2, 865, 361	−1, 512, 813

[1] Gold valued at $20.67+ a fine ounce.
[2] Silver valued at 53.3 cents a fine ounce. Average New York price of bar silver.

The figures in the preceding table were obtained through cooperation between the United States Bureau of the Mint and the Bureau of Mines and were agreed upon after conference and adjustment between the two bureaus. They are therefore final for both.

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[1] Work on manuscript completed June, 1931.

The totals are based on bullion deposits in the United States mints and assay offices and on returns to the Bureau of the Mint from the smelting and refining companies. The distribution is adjusted by means of information collected by the Bureau of Mines directly from the producing mines and tabulated for the mine reports discussed later. The data for the total production and in part for the distribution are obtained from records of (1) the unrefined domestic gold and silver deposited in United States mints and assay offices, (2) the domestic gold and silver in fine bars reported by private refineries, and (3) the unrefined domestic gold and silver contained in ore and matte exported for reduction. The last item is very small.

Domestic smelters and refiners recovered 779,584 fine ounces of gold and 83,780,875 fine ounces of silver from foreign ores and bullion, an increase of 89,010 ounces of gold and of 4,911,764 ounces of silver compared with the corresponding figures for 1928. As usual in recent years, the foreign ores and bullion came mainly from Mexico, Canada, and Peru.

The value of the new gold used in the arts and manufactures in the United States in 1929 was $24,873,136, or 54.5 per cent of the domestic output of the United States, compared with $26,305,500 in 1928. The quantity of new silver used for such purposes was 30,977,559 fine ounces, or 50.5 per cent of the total domestic output, compared with 24,931,283 ounces in 1928. In addition to the new gold used in the arts and industries in 1929, $32,030,531 in gold recovered from waste material was also utilized. The total quantity of silver (new and old) used in the arts and manufactures was 42,359,082 ounces, or 6,811,419 ounces more than in 1928. It is estimated that not less than 10,000,000 ounces of silver was used in the photographic and chemical industries. In addition to the gold and silver derived from foreign and domestic ore and bullion, $24,187,990 in gold and 9,103,296 ounces of silver were recovered from old or obsolete jewelry, silverware, dental waste, and other material, including old film. Nearly all of the silver recovered is now handled by private refineries.

Gold and silver produced in the United States, 1792–1929

[The estimate for 1792–1872 is by R. W. Raymond, commissioner, and for the period since 1872 by the Director of the Mint]

Period	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value
1792–1847[1]	1, 186, 977	$24, 537, 000	309, 500	$404, 500
1848–1872	58, 279, 781	1, 204, 750, 000	118, 568, 200	157, 749, 900
1873–1929	159, 728, 469	3, 301, 880, 500	2, 997, 647, 727	2, 327, 133, 188
	219, 195, 227	4, 531, 167, 500	3, 116, 525, 427	2, 485, 287, 588

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[1] A careful investigation by Philip B. Bekeart (Soc. California Pioneers Quarterly, Sept. 30, 1924) appears to have definitely fixed Jan. 19, 1848, as the date of the discovery of gold by James W. Marshall at Sutters Mill, Coloma, Eldorado County, Calif., and to have shown that the flakes (not a nugget) found by Marshall are now in the National Museum, Washington, D. C.

The average commercial value per fine ounce of silver for the total recorded domestic production is $0.797.

PRICES OF SILVER

The average monthly prices of fine bar silver in New York in 1929 were as follows:

Price of silver per fine ounce in 1929, by months

January	$0.57329	August	$0.52891
February	.56517	September	.51364
March	.56658	October	.50226
April	.55980	November	.49927
May	.54435	December	.48787
June	.52740		
July	.52822	Average	.53306

Price of silver per fine ounce, 1920–1929 [2]

1920	$1.09	1925	$0.694
1921	1.00	1926	.624
1922	1.00	1927	.567
1923	.82	1928	.585
1924	.67	1929	.533

The yearly price of silver has shown a regular downward trend, in the main, from $1.337 and $1.339 in 1865 and 1866 to $0.507 in 1915. The World War caused the price to advance; the downward trend was steady from 1923 to 1929, although the decrease from 1924 to 1927 was less than 11 cents an ounce. There was an increase of about 2 cents an ounce in 1928, followed by a decrease of about 5 cents in 1929. After March, 1929, the average monthly price decreased gradually but steadily until the end of the year. The average price in 1930 will approximate 15 cents lower than that for 1929, as the price of silver decreased to 35 and 36 cents in the fall of 1930.

More than half the world output of silver is derived from ores valued chiefly for their metals other than silver, so that the price of silver has less weight in encouraging the bulk of silver production than that of other metals associated with it. Only about one-third of the world silver output is derived from ores having silver as a highly predominant factor.[3]

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[2] Average buying price of silver from domestic mines for 1920 to June 2, 1923; average New York price for all silver after that period.

[3] Merrill, Charles White, Economic Relations of Silver to Other Metals in Argentiferous Ores: Econ. Paper 10, Bureau of Mines, 1929, 29 pp.

IMPORTS AND EXPORTS[4]

Value of gold and silver imported into and exported from the United States, 1928 and 1929, by classes

	Imports	Exports	Excess of—	
			Imports	Exports
1928				
Gold:				
Contained in domestic ore and base bullion		$268, 517		$268, 517
Contained in foreign ore and base bullion	$14, 499, 910		$14, 499, 910	
Domestic bullion refined		411, 892, 524		411, 892, 524
Foreign bullion refined	102, 455, 023	5, 200, 226	97, 254, 797	
United States coin	47, 870, 221	143, 225, 401		95, 355, 180
Foreign coin	4, 072, 153	172, 673	3, 899, 480	
	168, 897, 307	560, 759, 341	115, 654, 187	507, 516, 221
Excess exports over imports				391, 862, 034
Silver:				
Contained in domestic ore and base bullion		51, 769		51, 769
Contained in foreign ore and base bullion	37, 331, 651		37, 331, 651	
Domestic bullion refined		64, 051, 823		64, 051, 823
Foreign bullion refined	28, 476, 770	20, 620, 905	7, 855, 865	
United States coin	1, 622, 489	225, 210	1, 397, 279	
Foreign coin	686, 419	2, 432, 309		1, 745, 890
	68, 117, 329	87, 382, 016	46, 584, 795	65, 849, 482
Excess exports over imports				19, 264, 687
1929				
Gold:				
Contained in domestic ore and base bullion		57, 787		57, 787
Contained in foreign ore and base bullion	17, 459, 761		17, 459, 761	
Domestic bullion refined	28, 129, 908	109, 228, 470		81, 098, 562
Foreign bullion refined	129, 962, 247	1, 372	129, 960, 875	
United States coin	96, 920, 998	7, 145, 173	89, 775, 825	
Foreign coin	19, 175, 718	150, 124	19, 025, 594	
	291, 648, 632	116, 582, 926	256, 222, 055	81, 156, 349
Excess imports over exports			175, 065, 706	
Silver:				
Contained in domestic ore and base bullion		5, 202		5, 202
Contained in foreign ore and base bullion	33, 487, 387		33, 487, 387	
Domestic bullion refined		62, 788, 418		62, 788, 418
Foreign bullion refined	24, 994, 216	13, 515, 301	11, 478, 915	
United States coin	2, 068, 861	44, 131	2, 024, 730	
Foreign coin	3, 389, 366	7, 054, 145		3, 664, 779
	63, 939, 830	83, 407, 197	46, 991, 032	66, 458, 399
Excess exports over imports				19, 467, 367

DOMESTIC SUPPLY

The total excess of imports of gold over exports for the period 1916 to 1929 was $1,745,577,000. The only years since 1916 in which exports of gold exceeded imports were 1919, when the excess was $292,000,000; 1925, when the excess was $134,000,000; and 1928, when the excess was $391,862,000. The large gain in the domestic supply of gold is illustrated best by the following figures, which show the excess of imports over exports for each of these years: In 1916, $530,000,000; in 1917, $180,000,000; in 1918, $21,000,000; in 1920, $95,000,000; in 1921, $667,000,000; in 1922, $238,000,000; in 1923, $294,000,000; in 1924, $258,000,000; in 1926, $98,000,000; in 1927, $6,000,000; and in 1929, $175,000,000.

The domestic supply of new gold comes chiefly from dry and siliceous ore and from placer gravel worked largely by dredges.

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[4] Figures on imports and exports compiled by J. A. Dorsey, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

These two sources yielded 90.2 per cent of the domestic gold in 1915, 78.5 per cent in 1926, 76.6 per cent in 1927, 75.1 per cent in 1928, and 72 per cent in 1929. Considerable gold is recovered also from the refining of copper bullion, especially from copper ores produced at mines in Arizona, Nevada, and Utah. The proportionate output from gold ore has tended to decrease with declining yield from many of the principal gold camps and that from copper ore to increase; the result is a general net decline in total yield of gold due to the preponderant proportion of the output from placers and from gold and gold-silver ores. The proportionate output of gold from copper ore was 7.2 per cent in 1915, 16.4 per cent in 1926, 17.4 per cent in 1927, 19.3 per cent in 1928, and 22.2 per cent in 1929.

In 1929 the domestic supply of new silver came chiefly from copper ore, lead-zinc ore, lead ore, and dry and siliceous silver and silver-gold ores, in the proportion of 29.49, 25.71, 19.22, and 18.25 per cent, respectively, compared with 25.46, 28.01, 23.18, and 19.25 per cent in 1928. In 1915 dry and siliceous ore yielded 36 per cent of the silver, copper ore 26 per cent, lead ore 27 per cent, and lead-zinc ore only 9 per cent. Thus the largest gain in the output of silver has been from lead-zinc ore and the greatest loss from dry and siliceous ore.

WORLD PRODUCTION

GOLD

The estimated value of the gold produced in the world from 1860 to 1929, inclusive, is $17,099,023,800. In 1929 the estimated production of the world is recorded as $403,033,000, a decrease of about $5,352,000 from that for 1928. There were increases of about $6,706,600 in 1928, $1,696,700 in 1927, $6,680,600 in 1926, $25,641,400 in 1924, and $48,344,200 in 1923. There was a decrease of $104,600 in 1925 and successive annual decreases from 1915 to 1922.

In a Bureau of Mines publication[5] the world production of gold from 1493 to 1927, inclusive, is estimated at approximately 1,003,560,000 ounces, of which 51.5 per cent was produced from 1901 to 1927.

In 1929 the production of the United States (excluding the Philippine Islands) decreased $1,821,000; that of Mexico $976,300; that of Australasia $2,116,100; that of Ecuador $149,700; that of Russia $4,134,400; that of British India $252,000; that of China $1,033,600; and that of Chosen $511,500. The production of South Africa increased $1,200,300; of Canada, $779,700; of Brazil, $150,200; and of Peru, $1,141,800.

For the last nine years the mines in the Union of South Africa (Transvaal, Natal, and Cape Colony) have been yielding more than half the world's supply of gold. The gold production of Canada is increasing, and that of Russia will increase slowly. Despite lower prices for base metals the trend in gold output in the United States in 1930 is uncertain, although the output of the Philippine Islands has doubled during the last two years and dredging in Alaska has increased considerably.

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[5] Ridgway, Robert H., Summarized Data of Gold Production: Econ. Paper 6, Bureau of Mines, 1929, 63 pp.

The following table shows the output of gold by countries, as given by the Bureau of the Mint, with slight changes resulting from late information.

World production of gold, 1924–1929

Country	1924	1925	1926	1927	1928	1929
North America:						
Canada	$31, 532, 400	$35, 880, 800	$36, 263, 100	$38, 300, 500	$39, 082, 000	$39, 861, 700
Central America	1, 800, 000	2, 000, 000	1, 800, 000	1, 500, 000	1, 250, 000	1, 100, 000
Mexico	16, 480, 100	16, 309, 900	15, 972, 300	14, 990, 700	14, 451, 700	13, 475, 400
United States[1]	50, 570, 300	47, 957, 000	46, 276, 300	43, 767, 500	44, 335, 300	42, 514, 300
South America:						
Argentina	60, 000	55, 000	50, 000	20, 000	20, 000	20, 700
Bolivia	19, 900	8, 000	6, 900	5, 000	10, 500	31, 000
Brazil	2, 990, 700	2, 243, 000	2, 110, 800	2, 120, 100	2, 069, 600	2, 219, 800
Chile	1, 400, 000	1, 265, 500	1, 222, 400	1, 240, 300	595, 500	595. 500
Colombia	2, 000, 000	1, 582, 400	1, 481, 300	1, 500, 000	833, 600	1, 000, 000
Ecuador	800, 000	900, 000	1, 291, 700	1, 328, 000	1, 541, 500	1, 391, 800
Guiana—						
British	131, 000	188, 300	134, 700	118, 100	110, 100	132, 000
French	1, 312, 600	831, 400	935, 100	999, 600	939, 700	61, 500
Netherland	214, 000	204, 700	155, 600	158, 800	113, 700	954, 700
Peru	2, 459, 000	2, 433, 800	2, 485, 600	1, 915, 400	1, 383, 000	2, 524, 800
Uruguay	200	------	------	------	------	------
Venezuela	358, 900	631, 400	631, 300	813, 800	997, 600	893, 200
Europe:						
Austria	40, 500	38, 500	27, 200	2, 700	6, 600	------
Czechoslovakia	186, 100	156, 800	159, 500	155, 000	143, 500	103, 700
France	409, 400	701, 800	868, 400	930, 400	1, 116, 500	1, 116, 500
Germany	132, 900	120, 900	107, 600	119, 600	112, 300	120, 300
Great Britain	------	------	------	------	2, 700	200
Greece	8, 000	------	------	10, 000	10, 000	10, 000
Italy	31, 900	39, 900	35, 200	44, 500	38, 600	31, 900
Rumania	871, 300	827, 400	1, 150, 400	1, 367, 800	1, 294, 600	1, 470, 800
Russia	19, 805, 100	20, 364, 900	20, 509, 700	21, 931, 800	24, 806, 200	20, 671, 800
Spain	20, 000	20, 000	20, 000	20, 000	15, 000	10, 000
Sweden	------	------	305, 700	305, 700	289, 400	206, 700
Yugoslavia	161, 500	156, 800	214, 700	256, 500	299, 100	381, 500
Asia:						
China	2, 218, 100	2, 218, 100	2, 273, 900	2, 067, 200	2, 067, 200	1, 033, 600
Chosen	2, 772, 700	3, 035, 100	3, 940, 500	3, 706, 800	3, 440, 000	2, 928, 500
East Indies—						
British	500, 000	500, 000	400, 000	------	------	------
Netherland	2, 571, 300	2, 743, 500	2, 384, 600	2, 337, 400	2, 278, 900	2, 230, 500
Federated Malay States	309, 300	292, 400	299, 200	221, 300	386, 400	505, 000
India, British	8, 193, 200	8, 140, 700	7, 937, 400	7, 943, 500	7, 773, 800	7, 521, 800
Indo-China	7, 200	7, 200	6, 600	6, 600	5, 300	10, 600
Japan	5, 054, 300	6, 557, 800	6, 364, 100	6, 383, 900	6, 905, 700	6, 905, 600
Philippine Islands	1, 651, 500	1, 945, 900	1, 886, 100	1, 639, 600	2, 204, 500	3, 320, 400
Sarawak	17, 700	14, 700	5, 000	5, 000	4, 100	29, 000
Taiwan	178, 800	186, 800	186, 800	303, 700	186, 300	186, 300
Turkey	19, 300	19, 300	19, 900	19, 900	18, 600	18, 600
Africa	219, 579, 700	218, 759, 600	226, 580, 500	228, 870, 700	233, 033, 400	235, 346, 900
Australasia	16, 536, 800	13, 961, 800	13, 481, 600	14, 251, 000	14, 212, 500	12, 096, 400
	393, 405, 700	393, 301, 100	399, 981, 700	401, 678, 400	408, 385, 000	403, 033, 000

[1] Philippine Islands excluded.

SILVER

The increase in the world production of silver in 1929 was 3,789,800 ounces. The largest increases were: United States (excluding the Philippine Islands), 2,807,300 ounces; Canada, 1,206,900 ounces; Germany, 292,000 ounces; Central America, 238,400 ounces; Mexico, 163,100 ounces; Spain, 132,700 ounces; and Australasia, 129,600 ounces. The largest decreases were: Bolivia, 822,600 ounces; Burma, 126,700 ounces; and Peru, 112,500 ounces. The United States and Canada produced 32 per cent of the total (31 per cent in 1928); Mexico, Central America, and South America produced 53 per cent; and all other countries—mainly Australasia, Burma, Japan, and Spain—produced only about 15 per cent.

About 55 per cent of the world output of silver is produced or refined in the United States, but a large part of it is consumed in China, India, and Europe. Only about one-half of the domestic mine production of silver of the United States is consumed by domestic arts and industries. The remainder, and all the silver from foreign ores and bullion, must find a foreign market.

World production of silver, 1924–1929, in fine ounces

Country	1924	1925	1926	1927	1928	1929
North America:						
Canada	19,736,300	20,229,000	22,371,900	22,736,700	21,936,400	23,143,300
Central America	2,686,200	2,700,900	3,499,100	3,154,000	2,558,500	2,796,900
Mexico	91,486,100	92,885,500	98,291,200	104,573,900	108,537,300	108,700,400
United States[1]	65,366,800	66,106,900	62,673,000	60,394,200	58,426,000	61,233,300
South America:						
Argentina	20,000	18,000	15,000	15,000	15,000	15,000
Bolivia	4,857,600	4,346,500	5,834,000	5,402,800	5,638,800	4,816,200
Brazil	28,600	1,800	20,700	15,600	25,600	21,000
Chile	3,357,700	3,261,700	2,876,900	2,900,000	1,436,700	1,436,700
Colombia	2,900	2,900	126,000	131,400	68,200	60,000
Ecuador	70,000	70,000	80,000	87,600	79,800	96,500
Guiana	8,700	8,500	8,000	8,000	7,500	7,500
Peru	18,717,100	19,917,400	21,499,800	18,295,400	21,607,700	21,495,200
Venezuela	2,700	3,200	3,200	3,200	4,000	4,000
Europe:						
Austria	28,700	23,900	14,100	9,700	18,900	10,600
Czechoslovakia	732,500	707,300	765,500	750,000	767,700	723,000
France	147,900	352,000	261,800	308,600	360,100	360,100
Germany	3,753,000	4,780,400	5,358,900	5,293,400	5,220,800	5,512,800
Great Britain	31,200	32,400	41,300	46,700	32,800	36,000
Greece	160,700	254,300	254,300	241,100	241,100	241,100
Italy	497,000	320,800	519,400	537,100	514,400	518,700
Norway	424,400	504,700	308,600	315,100	398,700	322,300
Poland	192,900	212,200	271,700	250,000	235,100	360,600
Rumania	72,200	76,600	93,700	140,700	100,000	90,700
Russia	250,000	250,000	250,000	321,500	380,000	300,000
Spain	2,880,000	3,303,900	3,000,700	3,056,600	2,526,500	2,659,200
Sweden	------------	------------	80,400	80,400	75,000	75,000
Yugoslavia	31,200	26,100	45,000	53,800	62,700	80,000
Asia:						
Burma	5,284,200	4,831,500	5,100,000	6,000,000	7,400,000	7,273,300
China	110,000	110,000	135,000	100,000	100,000	50,000
Chosen	54,700	70,300	51,900	51,400	56,100	54,700
East Indies, Netherland	2,083,300	2,385,000	2,363,800	2,285,800	2,032,000	1,967,900
India, British	25,000	23,400	25,000	24,800	25,800	25,000
Indo-China	------------	------------	------------	10,200	53,200	3,200
Japan	3,542,300	4,835,500	4,776,100	4,531,500	5,144,900	5,144,900
Philippine Islands	43,100	68,500	44,000	28,400	36,400	101,500
Taiwan	11,000	13,200	14,300	18,100	11,700	11,800
Turkey	219,900	219,900	225,000	225,100	220,000	220,000
Africa:						
Algeria	------------	96,500	169,100	118,100	117,400	167,000
Bechuanaland	------------	500	400	400	100	200
Belgian Congo	------------	------------	------------	10,600	10,600	12,000
British West Africa (Gold Coast, Ashanti, Nigeria)	------------	------------	------------	------------	100	------------
East Africa, Portuguese	------------	1,300	1,100	700	300	100
Rhodesia	401,300	158,000	117,800	131,600	103,900	100,500
Tanganyika	700	1,000	800	900	1,600	1,000
Transvaal, Cape Colony, Natal	1,396,900	1,161,500	981,300	1,011,700	1,031,400	1,031,800
Australasia	10,769,900	10,841,000	11,225,400	10,309,300	10,304,400	10,434,000
	239,484,700	245,214,000	253,795,200	253,981,100	257,925,200	261,715,000

[1] Philippine Islands excluded.

The exports of silver in 1929 were valued at about $3,974,800 less than in 1928. Exports of domestic refined silver bullion amounted to 118,402,879 ounces, of which 15,872,544 ounces went to India, 93,903,727 ounces to China, and 2,924,859 ounces to Germany and

Great Britain. The monthly range in the average price of silver in 1929 was about 9 cents an ounce; the long expected crash in the price of silver had started, not to be halted until it reached as low as 25 cents. No large purchase of silver for coinage in 1929 was apparent, but the domestic demand for the arts and manufactures was above normal. There has been considerable agitation for a more extended use of silver for subsidiary coins and the use of a large proportion of silver in alloys used in European coinage, but the people have begun to realize that such coins are only tokens so that it will be difficult to induce governments to use more silver and less base metal in coinage.

Suggestions have been made that, as China will require foreign loans to stabilize its new régime, the United States could lend her large sums payable in silver bullion and in silver dollars at low rates of interest. So far there has been no enthusiastic response to the proposal by the Chinese Government, nor has it been shown that the shipment of silver bullion or coin in payment of such a loan would not curtail normal exports of silver to China.

Brownell[6] has proposed that European countries purchase about 20,000,000 to 25,000,000 ounces of silver for subsidiary coinage when the average price is below 50 cents an ounce and also that India and other countries refrain from marketing any government-owned silver when the price is below 52 to 55 cents an ounce. He believes that there has been no overproduction of silver and that the abnormal decrease in the price is due solely to the sales of government-owned silver.

MINE REPORT

METHOD OF COLLECTING STATISTICS

The first table in this report presents the final official figures of the production of gold and silver in the United States in 1929 as agreed upon by the Bureau of the Mint and the Bureau of Mines. With the comparatively unimportant exceptions of domestic gold and silver contained in ore and matte exported for reduction during the year, these figures record the production of gold and silver bullion from domestic ore in marketable form as metals, either refined or unrefined.

To trace this total gold and silver produced back to its source by States, counties, and mining districts, the Bureau of Mines makes a systematic investigation of the "mine production" of ores containing gold and silver and of the output of the placer mines, the output being classified by methods of production and by kinds of ore, as well as by mining districts. The resulting figures form the basis of the mine reports.

Of the two plans for ascertaining the gold and silver production, one is a measure of the metallurgic industry and the other a measure of the mining industry; one reports the metal actually recovered in marketable form and the other the mine output and its recoverable content. The two methods will not produce exactly corresponding results, but the figures for a period of years sufficiently long to compensate for overlap or lag should agree within allowable limits of error.

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[6] Brownell, Francis H., Improving World Trade Condition by Informally Stabilizing Silver: Min. Jour. (London), Feb. 14, 1931, pp. 133-135; Min. Jour. (London), Feb. 21, 1931, p. 167.

Gold and silver produced in the United States, 1905–1929, according to mint and to mine returns

Year	Mint		Mine	
	Gold	Silver	Gold	Silver
		Fine ounces		*Fine ounces*
1905–1919	$1, 343, 607, 200	942, 466, 023	$1, 332, 151, 915	941, 792, 228
1920	51, 186, 900	55, 361, 573	50, 537, 281	56, 559, 022
1921	50, 067, 300	53, 052, 441	49, 788, 750	46, 359, 147
1922	48, 849, 100	56, 240, 048	48, 932, 109	61, 235, 983
1923	51, 734, 000	73, 335, 170	51, 400, 382	70, 393, 639
1924	52, 277, 000	65, 407, 186	52, 180, 812	64, 113, 882
1925	49, 860, 200	66, 155. 424	49, 645, 444	66, 776, 275
1926	48, 269, 600	62, 718, 746	48, 075, 596	62, 533, 373
1927	45, 418, 600	60, 434, 441	45, 242, 438	59, 656, 876
1928	46, 165, 400	58, 462, 507	46, 308, 487	57, 909, 870
1929	45, 651, 400	61, 327, 868	45, 883, 477	60, 961, 491
	1, 833, 086, 700	1, 554, 961, 427	1, 820, 146, 691	1, 548, 291, 786

These figures show, according to the reports of the mint, a total excess of gold for the 25 years of $12,940,009, or a difference of 0.71 per cent, and a total excess of silver of 6,669,641 ounces, or a difference of 0.43 per cent. The small differences are fully accounted for in the detailed discussions of the subject in previous reports of this series.

UNITS OF MEASUREMENT

In the measurement of ores and concentrates the short ton of 2,000 pounds is used throughout. The price of gold is fixed by law at $20.67 + per fine ounce. The annual average prices for silver from 1920 to 1929 are given on page 879.

MINES PRODUCING

LEADING GOLD PRODUCERS

About $29,737,500 in gold, or about 70 per cent of the mine output of the United States (the Philippine Islands excluded) in 1929, was produced by 25 companies, none of which produced less than $304,000. As in former years, the Homestake mine in South Dakota was much the largest producer. The Alaska Juneau ranked second in total output of gold, and the Utah Copper Co. ranked third. The largest output by gold dredging was made by the Yuba Consolidated Goldfields of California, but the Hammon Consolidated Gold Fields of Nome, Alaska, may be the largest producer in 1930. Eight of these large producers of gold in 1929 were in California, 4 each in Arizona and Utah, 3 in Alaska, 2 in Nevada, and 1 each in Colorado, Montana, New Mexico, and South Dakota. Ten of these companies produced gold from dry and siliceous ore; 4 from gravel by dredging; 4 from copper ore; 1 from dry and siliceous ore, lead ore, and lead-zinc ore; 1 from copper ore and lead-zinc ore; 1 from copper ore and siliceous ore; 1 from copper ore and lead ore; 1 from copper ore, lead-zinc ore, and zinc ore; 1 from copper ore, lead ore, siliceous ore, and lead-zinc ore; and 1 from lead-zinc ore.

Larger producers of gold in the United States in 1929, in order of output

Rank	Operator	State	Mining district	Source of gold
1	Homestake Mining Co	South Dakota	Whitewood	Dry and siliceous ore.
2	Alaska Juneau Gold Mining Co	Alaska	Juneau	Do.
3	Golden Cycle Mining & Reduction Co.[1]	Colorado	Cripple Creek	Do.
4	Utah Copper Co	Utah	West Mountain	Copper ore and lead-zinc ore.
5	Yuba Consolidated Goldfields	California	Marysville	Dredging gravel.
6	Empire Star Mines Co. (Ltd.)	do	Grass Valley	Dry and siliceous ore.
7	Hammon Consolidated Gold Fields.	Alaska	Nome	Dredging gravel.
8	United Verde Copper Co	Arizona	Verde	Copper ore and siliceous ore.
9	Natomas Co. of California	California	Oroville and Folsom	Dredging gravel.
10	Nevada Consolidated Copper Co	Nevada	Robinson	Copper ore.
11	Fairbanks Exploration Co	Alaska	Fairbanks	Dredging gravel.
12	Calumet & Arizona Mining Co	Arizona	Warren	Copper ore.
13	Phelps Dodge Corporation (Copper Queen).	do	do	Copper ore and lead ore.
14	Elkoro Mines Co	Nevada	Jarbidge	Dry and siliceous ore.
15	Argonaut Mining Co	California	Alleghany	Do.
16	Anaconda Copper Mining Co	Montana	Summit Valley (Butte).	Mainly copper ore, lead-zinc ore, and zinc ore.
17	United States Smelting, Refining & Mining Co.	Utah	Park City	Copper ore, siliceous ore, lead ore, and lead-zinc ore.
18	Central Eureka Mining Co	California	Mother Lode	Dry and siliceous ore.
19	Kennedy Mining & Milling Co	do	Jackson	Do.
20	American Metal Co	New Mexico	Willow Creek	Lead-zinc ore.
21	Park Utah Consolidated Mines Co.	Utah	Blue Ridge and Snake Creek.	Dry and siliceous ore, lead ore, and lead-zinc ore.
22	Walker Mining Co	California	Spring Garden	Copper ore.
23	Original Sixteen to One Mines (Inc.).	do	Alleghany	Dry and siliceous ore.
24	Eureka Standard Mining Co	Utah	Tintic	Do.
25	New Cornelia Copper Co	Arizona	Ajo	Copper ore.

[1] Custom mill. Includes ore from Cresson, United Gold, and other mines.

Besides the output of these large operators, about $12,825,700 in gold came from about 3,200 placer and lode mines, not including those in the Philippine Islands. Some of them had substantial outputs, but the majority produced only small quantities of gold. The Benguet Consolidated Mining Co., Philippine Islands, according to its printed report, produced about $1,514,000 in gold in 1929, and the Balatoc mine in the same district as the Benguet mine produced about $1,177,500. Only four companies in the United States exceeded the output of the Benguet mine, and as the Balatoc mine is controlled by Benguet stockholders the combined output in 1929 was exceeded only by that of the Homestake and Alaska Juneau properties.

LEADING SILVER PRODUCERS

The output of silver from the 25 leading producing properties in 1929 was 40,380,500 ounces, or 66 per cent of the total. Fourteen of these properties each produced more than 1,000,000 ounces, and none yielded less than 607,000 ounces. The largest output of silver was that of the Anaconda Copper Mining Co., with an output double that of any other operator; the next largest producers were the Silver King Coalition Mines Co. and the Tintic Standard Mining Co., both in Utah. Five mines in Utah and four in Idaho each produced more than 1,000,000 ounces of silver in 1929. The output of the Presidio mine of the American Metal Co. in Texas decreased, but the mine remained the largest producer of silver from ore that contained no appreciable quantity of any other metal. Nine of these large producers were in Utah, 4 in Idaho, 3 each in Montana, Arizona, and Colorado, 2 in Nevada, and 1 in Texas. Four of these properties recovered silver from dry and siliceous ore; 3 from copper ore; 1 from lead ore; 1 from dry ore, copper ore, and lead-zinc ore; 3 from dry and siliceous ore, lead ore, and lead-zinc ore; 4 from lead ore and lead-zinc ore; 1 from dry and siliceous ore and lead ore; 2 from copper ore, lead ore, and lead-zinc ore; 1 from copper-lead ore; 3 from lead-zinc ore; and 2 from copper ore and lead-zinc ore.

Larger producers of silver in the United States in 1929, in order of output

Rank	Operator	State	Mining district	Source of silver
1	Anaconda Copper Mining Co.	Montana	Summit Valley (Butte).	Copper ore and lead-zinc ore.
2	Silver King Coalition Mines Co.	Utah	Uintah	Lead ore and lead-zinc ore.
3	Tintic Standard Mining Co.	do	Tintic	Lead ore and siliceous ore.
4	Bunker Hill & Sullivan Mining & Concentrating Co.	Idaho	Yreka	Lead ore.
5	Park Utah Consolidated Mines Co.	Utah	Blue Ledge and Snake Creek.	Dry and siliceous ore, lead ore, and lead-zinc ore.
6	United Verde Copper Co.	Arizona	Verde	Copper ore.
7	Sunshine Mining Co.	Idaho	Evolution	Copper-lead ore.
8	Hecla Mining Co.	do	Lelande	Lead ore and lead-zinc ore.
9	Federal Mining & Smelting Co.	do	Hunter and Warm Springs.	Do.
10	United States Smelting, Refining & Mining Co.	Utah	West Mountain	Lead ore, lead-zinc ore, and copper ore.
11	Calumet & Arizona Mining Co.	Arizona	Warren	Copper ore.
12	Utah Copper Co.	Utah	West Mountain	Copper ore, lead-zinc ore, and lead ore.
13	Butte & Superior Mining Co.	Montana	Summit Valley (Butte).	Copper ore and lead-zinc ore.
14	Magma Copper Co.	Arizona	Pioneer	Copper ore.
15	American Metal Co.	Texas	Shafter	Dry and siliceous ore.
16	Bingham Prospect Mining Co.	Utah	West Mountain	Lead ore, lead-zinc ore, and siliceous ore.
17	Empire Zinc Co.	Colorado	Battle Mountain	Dry ore, copper ore, and lead-zinc ore.
18	St. Joseph Lead Co.	Montana	Barker	Lead-zinc ore.
19	North Lily Mining Co.	Utah	Tintic	Lead ore and lead-zinc ore.
20	Rawley Mines (Inc.)	Colorado	Kerber Creek	Dry and siliceous ore.
21	Sunnyside Mining & Milling Co.	do	Eureka	Lead-zinc ore.
22	Tonopah Mining Co.	Nevada	Tonopah	Dry and siliceous ore.
23	Chief Consolidated Mining Co.	Utah	Tintic	Lead ore, siliceous ore, and lead-zinc ore.
24	New Quincy Mining Co.	do	Snake Creek	Lead-zinc ore.
25	Tonopah Extension Mining Co.	Nevada	Tonopah	Dry and siliceous ore.

NUMBER OF MINES

The following table indicates the number of mines that produced gold and silver in 1929. The placers are those in which the gold and the silver that is in natural alloy with the gold and, in a few placers, with platinum also are recovered from gravel and sand, whether by hand washing, sluicing, hydraulicking, drifting (in frozen ground or ancient buried river channels), or dredging. The lode mines are those producing gold and silver (from ore as distinguished from gravel) mainly from underground workings, including those whose ore is valuable chiefly for copper, lead, or zinc, but which contribute precious metals as by-products. In addition to producing mines here enumerated, many properties were being prospected and developed, and many other mining claims were being held by assessment work only.

The enumeration of placer mines is less satisfactory than that of lode mines, because some of the operations are only temporary and individually small and because much of the production is made by transitory miners not regularly working placer ground. The unit so far as possible is, as for lode mines, not the operator, but the mining claim or group of claims.

Number of mines in the United States producing gold and silver in 1929, by States [1]

State	Placer	Lode	Total
Alabama	1		1
Alaska [2]	465	28	493
Arizona	22	390	412
California	478	324	802
Colorado	13	290	303
Georgia	5	2	7
Idaho	51	147	198
Illinois [3]		3	3
Michigan [3]		2	2
Missouri [3]		2	2
Montana	40	212	252
Nevada	15	323	338
New Mexico	8	113	121
North Carolina	3	3	6
Oregon	111	45	156
Pennsylvania [3]		1	1
South Dakota		2	2
Tennessee [3]		2	2
Texas		9	9
Utah	3	127	130
Vermont		1	1
Washington	4	29	33
Wyoming		5	5
	1,219	2,060	3,279

[1] Philippine Islands excluded.
[2] Estimate for placer mines.
[3] Number of mines contributing to production of gold and silver.

Number of mines in the United States producing gold and silver, 1920–1929

Year	Placer	Lode	Total
1920	1,012	2,331	3,343
1921	1,357	1,967	3,324
1922	1,359	2,206	3,565
1923	1,295	2,188	3,483
1924	1,095	2,032	3,127
1925	1,236	2,445	3,681
1926	1,276	2,399	3,675
1927	1,280	2,048	3,328
1928	1,202	1,985	3,187
1929	1,219	2,060	3,279
Average	1,233	2,166	3,399

The total number of mines operated in 1929 was 120 less than the average for the last 10 years. The number of placer properties worked increased 17 compared with 1928 and was 1,097 less than the number operated in 1906. Increased operations were reported in Alaska, Arizona, California, New Mexico, Oregon, and Utah, with lessened activity in Colorado, Idaho, Montana, Nevada, and Washington. The number of lode mines operated was 75 more than in 1928 and 106 less than the average for the last 10 years.

Fair increases in the number of lode mines operated were recorded in Arizona, California, New Mexico, Oregon, and Utah; the largest decreases were in Colorado, Idaho, Montana, Nevada, and Washington.

MINE PRODUCTION

SUMMARY

Mine production of gold and silver in the United States in 1929, by States

State	Gold		Silver		Increase or decrease from 1928	
	Fine ounces	Value	Fine ounces	Value	Gold	Silver (fine ounces)
Alabama	9. 82	$203	1	$1	+$203	+1
Alaska	375, 438. 38	7, 761, 000	472, 900	252, 055	+916, 000	+18, 200
Arizona	202, 318. 14	4, 182, 287	7, 543, 283	4, 020, 570	+214, 799	+751, 932
California	412, 479. 25	8, 526, 703	1, 176, 895	627, 285	−2, 258, 612	−301, 876
Colorado	213, 689. 69	4, 417, 358	4, 397, 377	2, 343, 802	−887, 518	+345, 124
Georgia	124. 52	2, 574	16	9	+1, 663	+11
Idaho	20, 247. 11	418, 545	9, 414, 403	5, 017, 877	−15, 158	+416, 073
Illinois	------------	------------	3, 700	1, 972	------------	+554
Michigan	------------	------------	20, 795	11, 084	------------	+3, 642
Missouri	------------	------------	181, 638	96, 813	------------	+4, 798
Montana	54, 758. 03	1, 131, 949	12, 716, 977	6, 778, 149	−71, 071	+1, 863, 701
Nevada	163, 711. 22	3, 384, 211	4, 923, 526	2, 624, 239	−236, 622	−558, 048
New Mexico	35, 176. 46	727, 162	1, 121, 546	597, 784	+46, 802	+293, 753
North Carolina	244. 48	5, 054	21, 106	11, 249	+2, 688	+2, 055
Oregon	17, 092. 00	353, 323	30, 009	15, 995	+127, 355	−915
Pennsylvania	836. 02	17, 282	5, 972	3, 183	−3, 224	−1, 933
Philippine Islands	160, 619. 52	3, 320, 300	101, 480	54, 089	+1, 416, 238	+64, 053
South Carolina	------------	------------	------------	------------	−197	−1
South Dakota	316, 836. 85	6, 549, 599	85, 182	45, 402	−11, 206	−5, 365
Tennessee	565. 02	11, 680	81, 281	43, 323	+563	+5, 723
Texas	1, 278. 99	26, 439	1, 020, 516	543, 935	+16, 324	−320, 106
Utah	240, 419. 63	4, 969, 915	17, 592, 396	9, 376, 747	+575, 914	+519, 544
Vermont	------------	------------	3, 284	1, 750	------------	+3, 284
Washington	3, 719. 94	76, 898	47, 182	25, 148	−260, 269	−52, 556
Wyoming	48. 13	995	26	14	+318	−27
	2, 219, 613. 20	45, 883, 477	60, 961, 491	32, 492, 475	−425, 010	+3, 051, 621

The preceding table gives the quantity and value of the mine production of gold and silver in 1929, by States, as reported to the Bureau of Mines by the producing mines, and the increase or decrease by comparison with the corresponding figures for 1928.

The principal gold-producing States in 1929 were California, Alaska, South Dakota, Utah, Colorado, Arizona, and Nevada, and these States supplied 87 per cent of the total output. The only change in order of output is that Utah succeeds Colorado in fourth place. The notable increases in output in 1929 were in Alaska, Arizona, New Mexico, Oregon, the Philippine Islands, Texas, and Utah. The greatest increase ($1,416,238) was in the output from the Philippine Islands; the output from this source in 1930 probably will exceed that of Nevada. The States reporting large decreases in the output of gold in 1929 were California, Colorado, Idaho, Montana, Nevada, and Washington.

The principal silver-producing States in 1929 were Utah, Montana, Idaho, Arizona, Nevada, and Colorado, and these States produced about 93 per cent of the total; their ranking order was the same as for the four preceding years. There were large increases in output of silver from Arizona, Colorado, Idaho, Montana, New Mexico, the Philippine Islands, and Utah and important decreases from California, Nevada, Texas, and Washington. The decreases were due chiefly to lower recoveries from siliceous ores. No base ores are treated in the Philippine Islands, and the increase in silver was due entirely to the larger quantity of bullion from lode gold mines.

ORE PRODUCTION, CLASSIFICATION, AND AVERAGE VALUE

The best index of lode mining is found in the quantity, metallic content, and value of ore mined, rather than in the number of mines or of operators. In the next table are given the production of ore from mines producing gold and silver and the average extraction value of precious metals per ton.

The classification adopted is necessarily arbitrary in part. The complex nature of western ores especially and the gradations from one well-recognized class to another render essential a fixed terminology. The dry and siliceous ores comprise gold and silver ores proper, as well as fluxing ores carrying considerable quantities of iron and manganese oxides and very small quantities of gold and silver, and precious metal-bearing ores carrying copper, lead, or zinc in quantities too low to classify them as copper, lead, zinc, or mixed ores. The distinction between gold and silver ores is not here made. The total number of silver mines and the total production of true silver ore are both comparatively small. The copper ores include those containing 2.5 per cent or more of copper, or less than this percentage in the great disseminated copper deposits of the West and in the Lake Superior ores. In general, the lead ores are those containing 5 per cent (dry assay) or more of lead, and the zinc ores are those containing 16 per cent or more of zinc, both irrespective of their precious-metal content; but ores of lower grades in lead and especially in zinc are treated profitably in many districts, and, of course, they are then classified as lead or zinc ores, as the case may be. The mixed ores are combinations of those enumerated.

The lead, zinc, and lead-zinc ores in most districts in the Eastern and Central States carry no appreciable quantity of gold or silver, and such ores are excluded from this report. With the increase in the use of flotation and the recovery of zinc concentrates from lead ore in southeastern Missouri there has been an increase in the total quantity of silver recovered in Missouri, as these zinc concentrates contain 18 to 20 ounces of silver a ton. Singularly, the lead concentrates from the lead ore treated in southeastern Missouri contain very little silver, approximately less than 5 per cent of that contained in the zinc concentrates. The proportion of silver derived from the total quantity of crude lead ore milled is very small.

The total quantity of ore sold or treated annually, from which gold or silver was produced, decreased from 68,000,000 tons in 1918 to 21,500,000 tons in 1921. It then increased steadily until 1926, when the total was 65,787,864 tons; in 1927 the total quantity of ore was 64,526,920 tons; in 1928, 69,747,193 tons; and in 1929, 75,653,924 tons, much the largest output ever recorded. Notwithstanding the large increase in output of ore (nearly 6,000,000 tons) the value of the gold decreased $425,000.

Ore produced in the United States and average extraction value of gold and silver per ton in 1929, by States [1]

State	Dry and siliceous ore		Copper ore		Lead ore		Zinc ore		Copper-lead and copper-lead-zinc ores		Lead-zinc ore		Total (short tons)
	Short tons	Average value	Short tons	Average value	Short tons	Average value	Short tons	Average value	Short tons	Average value	Short tons	Average value	
Alaska	3,900,000	$0.95	590,400	$0.32									4,490,400
Arizona	89,904	6.09	25,669,975	.28	46,476	$4.10	[2] 88		19,908	$3.72	34,421	$4.57	25,860,772
California	573,724	7.90	1,080,355	.65	2,966	13.41			24	32.25			1,657,069
Colorado	640,442	7.98	36,539	13.13	36,880	6.10			81	29.14	458,251	1.96	1,172,193
Georgia	130	5.00											130
Idaho	26,583	10.59	91,782	.93	1,021,203	2.46	5	$0.60	84,138	12.78	950,414	1.47	2,174,125
Michigan			[3] 28,094	.39									28,094
Montana	102,268	9.68	3,802,976	1.19	15,436	6.69	430,971	2.01	51,725	1.71	320,069	4.13	4,723,445
Nevada	537,664	6.29	6,572,404	.23	74,839	5.67	177	1.14	56,644	4.89	113,772	3.48	7,355,500
New Mexico	4,858	10.09	4,114,187	.12	16,265	1.62	[2] 63,088		2,367	4.51	306,042	2.40	4,506,807
North Carolina	2,880	.87	[4] 73,229	.20									76,109
Oregon	6,673	16.91	3,836	2.22									10,509
Pennsylvania			[5] 1,289,266	2.58									1,289,266
South Dakota	1,463,159	4.51											1,463,159
Tennessee			825,300	.07			(2)						825,300
Texas	62,396	9.12	1,456	.98					20	1.55			63,872
Utah	255,192	8.60	17,895,332	.21	374,802	9.02	[2] 43		44,219	1.47	1,262,387	3.97	19,831,975
Vermont			31,529	.06									31,529
Washington	5,162	13.63	34,145	.62	3,176	.69					51,044	.04	93,527
Wyoming	115	8.69	28	.36									143
	7,671,150	3.67	62,140,833	.31	1,592,043	4.40	494,372	1.76	259,126	6.15	3,496,400	2.84	75,653,924
Percentage	10.14		82.15		2.11		0.65		0.34		4.62		100.00
1928:													
Total	8,094,743	3.86	55,870,147	.31	[6] 1,686,631	5.09	161,311	.44	351,141	4.09	[6] 3,583,220	3.09	69,747,193
Percentage	11.61		80.10		2.42		0.23		0.50		5.14		100.00

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[1] Illinois, Missouri, and Philippine Islands excluded; quantity of crude ore containing gold and silver not known. About 235,000 tons of gold ore was treated at mills in the Philippine Islands and the recovery in gold and silver was $14.36 a ton.

[2] Zinc ore yielded no gold or silver.

[3] Includes only copper ore that yielded silver.

[4] Includes only copper ore that yielded gold and silver.

[5] Ore is pyritiferous magnetite yielding 7,940 tons of low-grade copper concentrates; value given is per ton of concentrates.

[6] Change in total caused by slight revision in Washington; for details see mine report on Gold, Silver, Copper, Lead, and Zinc in Washington in 1929.

Arizona led in total quantity of ore produced by more than 6,028,000 tons, with 99 per cent of its output copper ore; Utah ranked second, with 90 per cent copper ore; Nevada was third, with 89 per cent copper ore; Montana was fourth, with 81 per cent copper ore; and New Mexico, Alaska, Idaho, California, and South Dakota followed in order. Ninety-one per cent of the ore from New Mexico was copper ore, and most of the remainder was lead-zinc ore. The output from Idaho was mainly lead ore and lead-zinc ore, that from South Dakota was all siliceous ore, and that from Alaska was 87 per cent siliceous ore and the remainder copper ore. Nearly twice as much copper ore as siliceous ore was treated from California mines. Fifty-five per cent of the ore from Colorado was siliceous ore, and 39 per cent was lead-zinc ore.

The quantity of copper ore sold or treated in 1929 increased about 6,270,700 tons, or 11 per cent, largely because of increased production in Arizona, California, Idaho, Montana, Nevada, New Mexico, Tennessee, and Utah; increases in the output of copper ore were also recorded in other States. The quantity of lead ore (containing gold or silver) decreased 94,588 tons, although there were small increases in Colorado, Montana, New Mexico, Utah, and Washington. The quantity of zinc ore (containing gold or silver) increased considerably, due entirely to larger shipments from mines in Montana. The quantity of lead-zinc ore decreased 86,820 tons, largely the result of decreased shipments of ore classed as lead-zinc ore from Montana; the States showing an increased output of lead-zinc ore in 1929 were Arizona, Idaho, Nevada, New Mexico, Utah, and Washington. The quantity of copper-lead ore and copper-lead-zinc ore was 92,015 tons less than in 1928; Idaho, Montana, Nevada, and Utah produce the bulk of these classes of ore. The output of dry and siliceous ore decreased 423,593 tons, following a decrease of 454,977 tons in 1928. The only large increases were in Alaska, Idaho, South Dakota, and Utah. The largest decreases were in California, Colorado, Arizona, Montana, Texas, and Washington.

The value of the gold and silver recovered from 67,982,774 tons of base ores in 1929 was $38,410,729 ($31,328 more than in 1928), an average of 57 cents a ton, of which about 17.5 cents or nearly one-third of the total represents gold. The average recovery from dry and siliceous ore in 1929 was $2.90 in gold a ton, so that 1 ton of such ore yielded 16.5 times as much gold as 1 ton of ore of all other classes combined and 19 times as much as was derived from 1 ton of copper ore, which constituted more than 82 per cent of the total quantity of ores containing gold and silver in 1929. The large increase in the output of copper ore in 1929 added about $890,600 to the output of gold from that source, compared with 1928. The gold from copper ore or from lead ore and lead-zinc ore will not increase in 1930, and as the bulk of the base ores is in these classes the output of gold from base ores will not increase greatly in the near future.

The total value of gold from base ores in 1929 exceeded that in 1928 by $848,600, and the quantity of base ores containing gold and silver increased 6,330,300 tons.

In 1929 the lead ore of Utah showed an average recovery in gold and silver of $9.02 a ton and that of Idaho, which produced 64 per cent of the total output of lead ore containing gold and silver, only $2.46 a ton. Lead ore from Nevada (74,839 tons) yielded $5.67 a ton and that from Colorado (36,880 tons), $6.10 a ton. In the output of ore considered as producing gold and silver the proportion of dry and siliceous ore decreased from 11.61 to 10.14 per cent, that of lead ore decreased from 2.42 to 2.11 per cent, and that of copper ore increased from 80.10 to 82.15 per cent. The proportion of all other classes of ore combined decreased from 5.87 per cent of the total in 1928 to 5.61 per cent in 1929.

During the period 1906 to 1929 the peak of production of dry and siliceous ore was reached in 1916, although the proportion of such ores to the total was largest in 1906. The extraction value of this ore varies greatly, depending largely on the quantity of low-grade ores milled in Alaska and South Dakota; the bulk of ore of this class comes from these two States. In 1929 Alaska produced 51 per cent of the dry and siliceous ore treated and South Dakota 19 per cent. Most of this output was milled at two properties.

The average recovery of gold and silver from dry and siliceous ore decreased steadily from $6.98 a ton in 1922 to $3.59 in 1927. In 1928 the recovery increased to $3.86 a ton, mainly as the result of the increased recovery a ton in ore milled in Alaska. The average recovery from dry and siliceous ore in 1929 was $3.67 a ton. The decided decrease in the average extraction value of gold and silver in copper ore—from $1.55 a ton in 1906 to 31 cents in 1928 and 1929—was caused by the lower price of silver and the low gold and silver content of the much increased quantity of copper ore from Arizona, New Mexico, Nevada, and Utah. Silver predominates over gold in nearly all lead ore. Mines in Utah contributed 74 per cent of the gold from this class of ore. As the price of silver fluctuates the average extraction value shows a wider range than the quantity of ore. The recovery of gold and silver from lead ore in 1929—$4.40 a ton—was lower than in any year since 1915. Zinc ore constituted less than 1 per cent of the total ore shown in the table on page 891; its extraction value was only $1.76 a ton, mainly in silver. The lead-zinc ore yielded an average of only 45 cents a ton in gold, but about 4.5 ounces of silver a ton was reported. The copper-lead and copper-lead-zinc ores treated in 1929 decreased in quantity and yielded $6.15 in gold and silver a ton. The gold content of these classes of ore is not important, but they contain good values in silver; those treated in 1929 averaged about 11 ounces of silver to a ton of crude ore. The gold recovered from such ores averaged only about 31 cents a ton.

Ore produced in the United States and average extraction value of gold and silver per ton, 1920–1929[1]

Year	Dry and siliceous ore		Copper ore		Lead ore	
	Short tons	Average value	Short tons	Average value	Short tons	Average value
1920	8, 590, 139	$6. 26	32, 447, 410	$0. 52	2, 368, 619	$8. 26
1921	8, 436, 214	6. 65	10, 930, 888	. 54	2, 053, 575	7. 89
1922	8, 728, 222	6. 98	23, 356, 128	. 56	2, 123, 673	8. 24
1923	9, 121, 719	5. 91	41, 596, 309	. 42	2, 287, 494	7. 56
1924	8, 979, 113	5. 21	44, 887, 379	. 39	2, 358, 602	5. 71
1925	8, 994, 910	4. 57	47, 186, 114	. 42	2, 271, 077	6. 20
1926	8, 743, 386	4. 03	51, 064, 058	. 36	2, 023, 572	5. 26
1927	8, 549, 720	3. 59	49, 966, 438	. 32	2, 004, 729	4. 89
1928	8, 094, 743	3. 86	55, 870, 147	. 31	[2] 1, 686, 631	5. 09
1929	7, 671, 150	3. 67	62, 140, 833	. 31	1, 592, 043	4. 40

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[1] Arkansas, Illinois, Missouri, Philippine Islands, and Porto Rico excluded; quantity of crude ore containing gold and silver not known.

[2] Change in total caused by slight revision in Washington; for details see mine report on Gold, Silver, Copper, Lead, and Zinc in Washington in 1929.

Ore produced in the United States and average extraction value of gold and silver per ton, 1920–1929—Continued

Year	Zinc ore		Copper-lead and copper-lead-zinc ores		Lead-zinc ore		Total (short tons)
	Short tons	Average value	Short tons	Average value	Short tons	Average value	
1920	482, 229	$3. 00	26, 890	$30. 01	1, 443, 904	$4. 10	45, 359, 191
1921	10, 116	. 76	14, 248	31. 76	122, 287	16. 96	21, 567, 328
1922	471, 172	3. 68	52, 370	13. 76	444, 845	7. 89	35, 176, 410
1923	723, 994	2. 55	162, 181	7. 30	1, 203, 698	3. 39	55, 095, 395
1924	145, 858	. 14	219, 874	3. 83	1, 791, 852	3. 14	58, 382, 678
1925	169, 432	. 79	228, 612	3. 44	2, 703, 471	3. 37	61, 553, 616
1926	214, 366	1. 03	282, 015	3. 38	3, 460, 467	3. 01	65, 787, 864
1927	452, 490	2. 18	418, 601	3. 07	3, 134, 942	2. 99	64, 526, 920
1928	161, 311	. 44	351, 141	4. 09	[2] 3, 583, 220	3. 09	69, 747, 193
1929	494, 372	1. 76	259, 126	6. 15	3, 496, 400	2. 84	75, 653, 924

[2] Change in total caused by slight revision in Washington; for details see mine report on Gold, Silver, Copper, Lead, and Zinc in Washington in 1929.

GOLD, BY SOURCES

As shown in the following table, 72 per cent of the domestic output of gold in 1929 was obtained from dry and siliceous ores—normally gold quartz and gold-silver quartzose ores—and from placers, compared with 75.08 per cent in 1928. The total contribution of gold from the great copper, lead, and zinc mines of the country was only 28 per cent, notwithstanding their enormous development and production of ore.

Mine production of gold in the United States in 1929, by States, in fine ounces [1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
Alabama	9. 82							9. 82
Alaska	199, 159. 88	176, 278. 50						375, 438. 38
Arizona	273. 43	16, 081. 99	179, 488. 76	2, 787. 97		1, 891. 02	1, 794. 97	202, 318. 14
California	187, 240. 60	204, 822. 40	20, 041. 03	360. 07		15. 15		412, 479. 25
Colorado	2, 217. 99	193, 119. 21	2, 974. 72	2, 287. 61		13. 91	13, 076. 25	213, 689. 69
Georgia	93. 27	31. 25						124. 52
Idaho	4, 129. 92	12, 830. 06	2, 371. 41	233. 34		6. 48	675. 90	20, 247. 11
Montana	596. 66	16, 974. 00	31, 030. 94	785. 51	1, 348. 14	97. 70	3, 925. 08	54, 758. 03
Nevada	2, 117. 00	90, 655. 65	65, 287. 67	3, 212. 86		727. 23	1, 710. 81	163, 711. 22
New Mexico	79. 82	977. 49	17, 300. 12	138. 68		1. 10	16, 679. 25	35, 176. 46
North Carolina	52. 48	12. 00	180. 00					244. 48
Oregon	11, 947. 13	4, 909. 98	234. 89					17, 092. 00
Pennsylvania [2]			836. 02					836. 02
South Dakota		316, 836. 85						316, 836. 85
Tennessee			565. 02					565. 02
Texas		1, 278. 99						1, 278. 99
Utah	46. 25	36, 172. 76	137, 353. 04	27, 422. 01		1, 187. 55	38, 238. 02	240, 419. 63
Washington	295. 76	3, 224. 85	189. 20	2. 10			8. 03	3, 719. 94
Wyoming		48. 13						48. 13
	408, 260. 01	1, 074, 254. 11	457, 852. 82	37, 230. 15	1, 348. 14	3, 940. 14	76, 108. 31	2, 058, 993. 68
Value	$8, 439, 483	$22, 206, 803	$9, 464, 658	$769, 616	$27, 869	$81, 450	$1, 573, 298	$42, 563, 177
Percentage	19. 83	52. 17	22. 24	1. 81	0. 06	0. 19	3. 70	100. 00
1928: Total	416, 831. 52	1, 195, 804. 28	414, 770. 70	[3] 35,959.75	130. 57	6, 972. 82	[2] 77, 594. 36	2, 148, 064. 00
Value	$8, 616. 673	$24, 719, 469	$8, 574, 071	[3] $743, 354	$2, 699	$144, 141	[3] $1,604,018	$44, 404, 425
Percentage	19. 41	55. 67	19. 31	1. 67	0. 01	0. 32	3. 61	100. 00

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[1] Philippine Islands excluded. Estimated output of gold from lode mines was 160,620 ounces; no gold was reported from placer mines.

[2] From pyritiferous magnetite ore.

[3] Change in total caused by slight revision in Washington; for details see mine report on Gold, Silver, Copper, Lead, and Zinc in Washington in 1929.

An examination of the domestic mine production of gold from different sources shows that the recovery from placer mines was 27 per cent of the total output for the period 1906 to 1910, inclusive, and only 22.5 per cent of the total output for the period 1921 to 1925, inclusive. In some later years placer mines have yielded the following percentages of the total output of gold: 1927, 21.4 per cent; 1928, 19.4 per cent; and 1929, 19.83 per cent. The recovery of gold from dry and siliceous ore was 67 per cent of the total output for the period 1911 to 1915, inclusive; it was only 55.2 per cent of the total in 1927, 55.7 per cent in 1928, and 52.17 per cent in 1929. The domestic gold recovered from copper ore has increased from about 5.8 per cent of the total for the period 1906 to 1908, inclusive, to nearly 17.5 per cent in 1927, 19.3 per cent in 1928, and 22.24 per cent in 1929. The recovery of gold from all other base ores was about 2.3 per cent of the total for the period 1906 to 1910, inclusive, nearly 6 per cent in 1927, 5.6 per cent in 1928, and 5.76 per cent in 1929. The gold from copper ore and other base ores may increase in future years, but this increase must be proportionately small. Any large increase in the output of gold must come from siliceous ores, and no new large ore bodies of this class have been discovered recently. Dredge mining is now the only large source of placer gold, and the area that can be mined by that process is steadily declining. The output from dredges in California is decreasing, although some new territory is being operated. New dredges at Nome have increased the output of placer gold in Alaska, but it is improbable that their output will compensate fully for a lessened output elsewhere. Even though there may be increased operations at some of the larger gold mines, owing to the lower cost of labor and supplies, no recent developments have occurred that will tend to increase greatly the total yield of domestic gold in 1930 or 1931; also, the total effect of the lessened activity at base-metal mines upon domestic gold output is still undetermined.

Gold produced in the United States, by sources, as reported by mines, 1920–1929, in fine ounces [1]

Year	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
1920	603,002	1,523,331	171,055	46,776	3,657	3,731	31,435	2,382,987
1921	677,435	1,548,251	52,765	61,924	76	159	4,400	2,345,010
1922	537,910	1,560,789	130,928	35,415	2,807	2,467	22,935	2,293,251
1923	551,929	1,510,098	271,690	38,109	3,321	3,801	25,965	2,404,913
1924	450,720	1,602,469	310,413	39,947	227	1,995	38,560	2,444,331
1925	436,251	1,414,446	348,025	50,378	375	5,515	52,384	2,307,374
1926	457,717	1,295,570	365,223	45,724	1,194	3,335	63,763	2,232,526
1927	451,215	1,162,404	367,639	41,504	1,563	2,631	80,076	2,107,032
1928	416,832	1,195,804	414,771	[2] 35,960	130	6,973	[2] 77,594	2,148,064
1929	408,260	1,074,254	457,853	37,230	1,348	3,940	76,108	2,058,993

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[1] Philippine Islands and Porto Rico excluded.

[2] Change in total caused by slight revision in Washington; for details see mine report on Gold, Silver, Copper, Lead, and Zinc in Washington in 1929.

PLACERS

General features.—The output of gold from placer mines in the United States (no placer gold was reported from the Philippine Islands) in 1929 was 408,260 ounces, compared with 416,832 ounces in 1928. As Alaska produced 199,160 ounces, California 187,241 ounces, and Oregon 11,947 ounces, less than 10,000 ounces came from placers in all other States. The States showing the largest decreases were California (47,408 ounces), Colorado (753 ounces), and Idaho (4,062 ounces). States showing large increases in placer gold were Alaska (37,249 ounces) and Oregon (6,117 ounces). Placer mines in Alabama, Georgia, New Mexico, North Carolina, Utah, and Washington yielded more gold in 1929 than in 1928, but their output was small and unimportant. The placer gold is derived chiefly from dredging (which yielded 81 per cent of the total in 1929), from placers operated by hydraulicking, and from those worked by drift mining or by sluicing. The last two methods are relatively unimportant, except in Alaska, California, and Oregon. There is also a small annual output of gold from dry placer mining in Arizona, California, and New Mexico and of gold and platinum from ocean-beach mining in California and Oregon, but these sources are both insignificant as producers of gold.

Dredging.—The value of gold recovered by dredges in the United States from the commercial inception of the industry in 1896 to the end of 1929 has amounted, according to the most authentic data available, to $232,358,509, of which $163,553,943 came from California, $39,007,474 from Alaska, $9,592,435 from Montana, $8,140,421 from Colorado, $6,087,075 from Idaho, $5,342,211 from Oregon, and $634,950 from other States. The output of gold from dredges in 1929 was $6,831,301, compared with $6,892,331 in 1928; the number of dredges operated in 1929 was 63, compared with 57 in 1928. Of the total for 1929 California produced $3,589,259 from 25 dredges, Alaska $2,932,000 from 30 dredges, Idaho $60,143 from 3 dredges, Oregon $205,464 from 3 dredges, Colorado $38,497 from 1 dredge, and Washington $5,938 from 1 dredge. No dredges were operated in Montana, Nevada, or the Philippine Islands in 1929. Dredges in Alaska produced $747,000 more gold in 1929 than in 1928, and dredges in Oregon $115,361 more in 1929 than in 1928. The output of gold from dredges in California decreased $841,654 in 1929 and from dredges in Idaho, $73,275; Colorado dredges also produced much less gold in 1929 than in 1928. In only one year (1925) during the decade 1920–1929 was the output of gold from dredges lower than that in 1929.

Gold produced in the United States by dredges, 1920–1929

Year	Dredges	California	Alaska	Other States[1]	Total
1920	78	$6, 900, 366	$1, 129, 932	$1, 256, 158	$9, 286, 456
1921	72	7, 756, 787	1, 582, 520	1, 196, 261	10, 535, 568
1922	71	4, 999, 215	1, 767, 753	922, 300	7, 689, 268
1923	66	6, 065, 735	1, 848, 596	1, 084, 716	8, 999, 047
1924	63	4, 305, 521	1, 563, 361	1, 044, 099	6, 912, 981
1925	60	4, 750, 842	1, 572, 312	507, 874	6, 831, 028
1926	63	4, 950, 545	2, 291, 000	281, 240	7, 522, 785
1927	59	5, 461, 929	1, 740, 000	313, 661	7, 515, 590
1928	57	4, 430, 913	2, 185, 000	276, 418	6, 892, 331
1929	63	3, 589, 259	2, 932, 000	310, 042	6, 831, 301

[1] Colorado, Idaho, Montana, Nevada, Oregon, and Washington.

Further information on this subject may be found in previous issues of Mineral Resources, in reports of the Director of the Mint, and in reports of geological surveys or mining officials of the various States.

DRY AND SILICEOUS ORES

The siliceous ore comprises free-milling (amalgamating) ore, as in Alaska, California, and Oregon; both amalgamating and concentrating ore, as in many States; simply concentrating ore, as in parts of Colorado and Arizona; all-sliming and cyaniding ore, as in Nevada; and finally smelting ore. Tailings both from old dumps and from current millings are largely reworked by concentration and subsequent cyanidation or smelting. The material smelted consists mainly of concentrates and siliceous and pyritic ores, which are also valuable as fluxes. Figures of relative output by methods and by States are given on page 904.

As most of the gold produced in the United States is derived from placer gravel and dry and siliceous ores, including true gold, gold-silver, and silver ores, the following table for certain States is of special interest.

Gold produced in six Western States, 1925–1929

State and year	Total (lode and placer)			Gold ore				Gold-silver ore		Silver ore		Placer	
	Mines producing	Ore mined (short tons)	Gold (fine ounces)	Mines producing	Short tons	Gold (fine ounces)		Short tons	Gold (fine ounces)	Short tons	Gold (fine ounces)	Mines producing	Gold (fine ounces)
						Total	Average						
Arizona:													
1925	386	20,927,382	201,740.92	77	71,289	33,644.79	0.47	2,036	432.77	51,665	2,886.27	18	206.42
1926	383	22,382,685	234,010.97	74	111,083	47,586.24	.43	9,440	1,713.32	19,426	1,385.74	21	338.96
1927	308	21,991,874	200,494.59	77	122,153	27,032.05	.22	11,074	2,090.88	18,474	1,295.19	15	302.68
1928	320	22,828,766	191,927.23	74	52,089	17,844.40	.34	53,264	1,366.63	41,472	3,372.46	22	309.60
1929	412	25,860,772	202,318.14	69	68,891	14,428.87	.21	9,377	1,477.56	11,636	175.56	22	273.43
Idaho:													
1925	275	1,827,715	20,886.92	50	13,853	3,678.39	.27	434	317.89	3,848	58.25	85	12,692.92
1926	246	1,934,143	13,669.27	41	5,124	2,811.27	.55	44	107.85	694	76.05	69	8,360.45
1927	218	2,018,325	15,315.67	41	4,389	4,622.17	1.05	37	141.57	842	59.54	70	7,520.33
1928	207	2,054,329	20,980.38	46	10,304	11,149.07	1.08	201	37.37	66	9.40	56	8,191.63
1929	198	2,174,125	20,247.11	37	26,459	12,709.23	.48	7	81.24	117	39.59	51	4,129.92
Montana:													
1925	424	4,405,008	82,122.85	98	149,721	34,351.64	.23	1,209	276.45	43,761	3,453.34	93	1,905.25
1926	393	4,470,055	60,504.11	101	80,847	21,583.35	.27	1,415	482.70	11,309	1,744.02	58	1,104.30
1927	307	4,222,607	53,541.25	79	50,764	16,467.40	.32	170	138.94	61,042	1,782.96	60	1,079.97
1928	279	4,344,279	58,196.09	81	71,102	16,810.30	.24	207	146.14	41,022	1,535.66	43	865.14
1929	252	4,723,445	54,758.03	69	57,676	14,549.72	.25	847	540.78	43,745	1,883.50	40	596.66
Nevada:													
1925	424	4,927,139	187,104.72	156	129,914	59,519.79	.46	424,077	46,224.28	290,957	35,134.18	25	2,536.54
1926	405	5,884,568	175,381.68	139	141,967	51,699.25	.36	433,749	50,090.77	230,802	24,825.08	28	2,866.17
1927	409	5,531,152	150,346.16	158	294,308	66,615.25	.23	5,269	1,268.99	216,248	26,823.26	30	1,809.22
1928	359	7,057,433	175,157.79	142	419,043	73,223.74	.17	75,297	2,911.02	146,664	24,168.60	29	1,851.12
1929	338	7,355,500	163,711.22	118	384,381	65,742.36	.17	3,953	1,725.61	149,330	23,187.68	15	2,117.00
Utah:													
1925	179	14,479,247	177,803.08	8	8,087	2,411.08	.30	119,337	22,081.90	261,606	9,776.84		
1926	166	15,856,144	182,762.98	7	344	1,297.40	3.77	113,476	14,165.75	187,393	8,633.93	2	16.16
1927	123	15,757,074	193,908.82	7	4,226	3,390.88	.80	83,004	7,667.38	158,114	11,651.73		
1928	124	18,427,117	212,559.79	8	14,704	8,700.95	.59	36,063	7,848.56	160,991	9,024.27	3	46.00
1929	130	19,831,975	240,419.63	9	25,564	20,561.46	.80	55,001	7,331.56	174,627	8,279.74	3	46.25
Washington:													
1925	46	50,287	11,138.49	8	15,376	10,870.47	.71			7	5.72	9	52.87
1926	58	54,343	9,340.82	9	17,599	7,707.83	.44					9	1,354.50
1927	33	119,201	19,513.51	11	43,442	19,342.06	.45			8	.14	3	18.82
1928	38	64,554	16,310.45	13	33,898	16,097.84	.47			58	.76	1	90.85
1929	33	93,527	3,719.94	5	5,120	3,220.59	.63			42	4.26	4	295.76

Nearly all the siliceous ore in three of the largest gold-producing States—Alaska, California, and South Dakota—yields only a small quantity of silver and is classed as gold ore. The siliceous ore from Colorado includes some silver and gold-silver ore.

Siliceous ore treated and gold recovered per ton of ore treated, 1920–1929

Year	Alaska		California		South Dakota		Colorado	
	Ore treated	Recovery per ton	Ore treated	Recovery per ton	Ore treated	Recovery per ton	Ore treated	Recovery per ton
	Short tons	*Ounce*	*Short tons*	*Ounce*	*Short tons*	*Ounce*	*Short tons*	*Ounce*
1920	3, 413, 736	0. 063	788, 136	0. 439	1, 356, 098	0. 167	1, 224, 081	0. 257
1921	2, 894, 813	. 064	902, 566	. 402	1, 725, 669	. 185	1, 230, 172	. 250
1922	2, 513, 455	. 058	1, 052, 148	. 414	1, 751, 454	. 180	1, 296, 501	. 221
1923	2, 502, 901	. 045	925, 659	. 347	1, 665, 439	. 186	1, 166, 470	. 243
1924	3, 127, 876	. 042	1, 075, 858	. 364	1, 674, 720	. 177	1, 074, 876	. 344
1925	3, 573, 540	. 042	886, 625	. 413	1, 590, 079	. 182	1, 187, 054	. 271
1926	3, 924, 925	. 036	717, 326	. 433	1, 415, 785	. 197	1, 240, 195	. 259
1927	4, 352, 000	. 033	619, 122	. 428	1, 376, 583	. 234	1, 035, 305	. 227
1928	3, 736, 500	. 045	797, 441	. 339	1, 422, 138	. 223	894, 455	. 266
1929	3, 900, 000	. 045	573, 724	. 357	1, 463, 159	. 217	640, 442	. 302

The quantity of siliceous ore treated in South Dakota in 1929 was 41,021 tons more than in 1928, but the recovery of gold per ton was about 12 cents less; the quantity of siliceous ore from California was 223,717 tons less, and the recovery of gold per ton was about 37 cents more; the quantity of siliceous ore treated in Alaska was 163,500 tons more, and the recovery of gold was about the same; and the quantity of siliceous ore treated in Colorado was 254,013 tons less, and the recovery of gold per ton was about 75 cents more. These four States yielded 86 per cent of the total dry and siliceous ore treated in 1929 and 83 per cent of the total gold from such ores.

COPPER ORE

The gold obtained as a by-product in the treatment of copper ore increased about $890,600 in 1929, following increases of $974,300 in 1928, $50,000 in 1927, and $355,500 in 1926. Copper ore yielded nearly 3 per cent more of the total gold in 1929 than in 1928. The largest producer of gold from copper ore in 1929 was Arizona, with about 39 per cent of the total; Utah, with 30 per cent, ranked second; and Nevada, with 14 per cent, ranked third; Montana, California, and New Mexico followed. The largest gains in gold derived from copper ore were in Utah (22,189 ounces), Arizona (18,418 ounces), California (3,364 ounces), Colorado (2,206 ounces), Idaho (1,812 ounces), and New Mexico (818 ounces).

LEAD ORE

The production of gold from lead ore increased about 4 per cent compared with the output in 1928. Utah showed an increase of 695 ounces and produced 74 per cent of all the gold recovered from lead ore. The output from lead ore in Colorado increased 1,106 ounces and that from Montana 211 ounces.

ZINC, LEAD-ZINC, AND MIXED ORES

Montana produced all the gold from zinc ore; Arizona, Nevada, and Utah produced most of that from copper-lead and copper-lead-zinc ores. The combined output of gold from these three classes of ore was only 5,288 ounces. Colorado, New Mexico, and Utah yielded 89 per cent of the gold from lead-zinc ore, and more than half of the gold from lead-zinc ore was from Utah mines. The output of gold from all these small sources was 3.94 per cent of the total gold in 1928 and 3.95 per cent in 1929.

SILVER, BY SOURCES

The mine production of silver in 1929 from the chief sources—copper ore, lead-zinc ore, lead ore, and siliceous ore—was 92.7 per cent of the total, compared with 95.9 per cent in 1928. The combined yield of silver from placer bullion, zinc ore, copper-lead ore, and copper-lead-zinc ore was 7.32 per cent in 1929, compared with 4 per cent in 1928. The production of silver in the United States, as reported to the bureau by the mines, was 60,860,011 ounces and was about three-fourths of that in the record year 1916. The combined output from lead and lead-zinc ores decreased from 29,627,087 ounces in 1928 to 27,344,541 ounces in 1929. The recovery from siliceous ore decreased 32,623 ounces and was the smallest annual recovery in more than a score of years, being 17,523,706 ounces less than that in the record year 1922. Mines in Nevada, Utah, and Colorado yielded 69 per cent of the silver from this class of ore. The recovery from copper ore increased 3,214,993 ounces over that in 1928. The total recovery of silver from base bullion was about 3,021,300 ounces more in 1929 than in 1928.

Mine production of silver in the United States in 1929, by States, in fine ounces [1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
Alabama	1							1
Alaska	26, 800	94, 370	351, 730					472, 900
Arizona	42	403, 508	6, 598, 986	249, 575		65, 591	225, 581	7, 543, 283
California	13, 312	554, 893	547, 183	60, 641		866		1, 176, 895
Colorado	548	2, 098, 226	784, 933	333, 369		3, 888	1, 176, 413	4, 397, 377
Georgia	8	8						16
Idaho	1, 419	30, 450	68, 410	4, 706, 508	5	2, 017, 528	2, 590, 083	9, 414, 403
Illinois [2]				3, 700				3, 700
Michigan			20, 795					20, 795
Missouri				181, 638				181, 638
Montana	71	1, 198, 531	7, 289, 007	163, 300	1, 576, 332	162, 243	2, 327, 493	12, 716, 977
Nevada	1, 025	2, 828, 537	255, 254	671, 478	378	491, 175	675, 679	4, 923, 526
New Mexico	4	54, 027	270, 385	43, 995		19, 989	733, 146	1, 121, 546
North Carolina	4	4	21, 098					21, 106
Oregon	1, 778	21, 341	6, 890					30, 009
Pennsylvania [3]			5, 972					5, 972
South Dakota		85, 182						85, 182
Tennessee			81, 281					81, 281
Texas		1, 017, 746	2, 671	41		58		1, 020, 516
Utah	15	2, 714, 111	1, 608, 570	5, 281, 243		75, 574	7, 912, 883	17, 592, 396
Vermont			3, 284					3, 284
Washington	98	6, 932	32, 377	4, 003			3, 772	47, 182
Wyoming		7	19					26
	45, 125	11, 107, 873	17, 948, 845	11, 699, 491	1, 576, 715	2, 836, 912	15, 645, 050	60, 860, 011
Value	$24, 052	$5, 920, 496	$9, 566, 734	$6, 235, 829	$840, 389	$1, 512, 074	$8, 338, 812	$32, 438, 386
Percentage	0. 07	18. 25	29. 50	19. 22	2. 59	4. 66	25. 71	100. 00
1928: Total	46, 276	11, 140, 496	14, 733, 852	[4] 13, 416, 657	117, 532	2, 207, 200	[4] 16, 210, 430	57, 872, 443
Value	$27, 071	$6, 517, 190	$8, 619, 304	[4] $7, 848, 744	$68, 756	$1, 291, 212	[4] $9, 483, 102	$33, 855, 379
Percentage	0. 08	19. 25	25. 46	23. 18	0. 20	3. 82	28. 01	100. 00

[1] Philippine Islands excluded. Mine output of silver in Philippine Islands in 1929 was reported as 101,480 ounces, all from dry and siliceous ores.

[2] From fluorspar-lead ores.

[3] From pyritiferous magnetite ore.

[4] Change in total caused by slight revision in Washington; for details see mine report on Gold, Silver, Copper, Lead, and Zinc in Washington in 1929.

Silver produced in the United States, by sources, as reported by mines, 1920–1929, in fine ounces[1]

Year	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Copper-lead and copper-lead-zinc ores	Lead-zinc ore	Total
1920	73, 383	20, 477, 612	12, 151, 424	17, 069, 506	1, 258, 341	669, 503	4, 837, 135	56, 536, 904
1921	81, 375	24, 117, 251	4, 782, 538	14, 912, 990	6, 163	449, 417	1, 983, 222	46, 332, 956
1922	60, 769	28, 631, 579	10, 376, 123	16, 756, 835	1, 676, 967	669, 809	3, 035, 907	61, 207, 989
1923	57, 752	27, 636, 947	14, 684, 333	20, 139, 928	2, 171, 186	1, 348, 025	4, 317, 503	70, 355, 674
1924	51, 251	20, 388, 065	16, 335, 433	18, 858, 782	24, 431	1, 194, 323	7, 218, 459	64, 070, 744
1925	50, 303	17, 099, 876	18, 051, 937	18, 777, 853	181, 886	970, 370	11, 577, 855	66, 710, 080
1926	49, 890	13, 567, 095	17, 039, 546	15, 528, 454	313, 119	1, 415, 699	14, 573, 416	62, 487, 219
1927	49, 829	11, 775, 384	14, 556, 572	15, 762, 197	1, 685, 764	2, 171, 792	13, 624, 144	59, 625, 682
1928	46, 276	11, 140, 496	14, 733, 852	[2] 13, 416, 657	117, 532	2, 207, 200	[2] 16, 210, 430	57, 872, 443
1929	45, 125	11, 107, 873	17, 948, 845	11, 699, 491	1, 576, 715	2, 836, 912	15, 645, 050	60, 860, 011

[1] Philippine Islands and Porto Rico excluded.

[2] Change in total caused by slight revision in Washington; for details see mine report on Gold, Silver, Copper, Lead, and Zinc in Washington in 1929.

PLACERS

The recovery of silver from the refining of placer bullion in 1929 was 45,125 ounces, or 1,151 ounces less than that in 1928. Of the total production 89 per cent came from Alaska and California. The bullion from placers in Nevada contained the largest percentage of silver. The bullion from placers in California contained the smallest percentage of silver. The fineness of placer bullion recovered in western mines varies greatly, so that operators of placer mines receive from about $14 to $19 an ounce for crude gold.

DRY AND SILICEOUS ORES

About 25.5 per cent of the mine production of silver from dry and siliceous ore came from Nevada, 24.4 per cent from Utah (mainly from the Tintic district), and 19 per cent from Colorado. The only large increases in the quantity of silver from siliceous ore were in Alaska, Montana, New Mexico, and Utah; the large decreases were in Arizona, California, Colorado, Nevada, Texas, and Washington.

A large part of the silver from gold-silver siliceous ore is obtained with the gold by amalgamation and cyanidation in the mills. Very little of the gold and silver ores is treated by flotation, which is so extensively used on base ores, and no estimate is available for the quantity so treated in 1929. Flotation in combination with amalgamation and cyanidation will be employed as a preliminary treatment of the ore to remove objectionable mineral constituents. This procedure will decrease cyaniding costs and make possible a higher recovery of gold and silver. The remainder of the silver is recovered by smelting and refining base bullion and by smelting some of the richer ore.

COPPER ORE

The silver produced from copper ore is nearly all obtained in the electrolytic refining of blister copper. The copper ore is mainly sulphide (except the Lake ore of Michigan, which consists of native metal in amygdaloid and conglomerate matrix), and a greater quantity contains chalcocite than chalcopyrite or cupriferous pyrite. The silver tenor of much of the copper ore, especially that of the Santa Rita district, New Mexico, of Bingham, Utah, and of Ely, Nev., is notably low, but other regions yield copper ore that contains considerable quantities of silver. The yield of silver from copper ore in 1929 was about 3,215,000 ounces greater than that in 1928 and was the largest ever reported from copper ore, except that for 1925. In output of silver from copper ore, Montana with a yield of 7,289,007 ounces (an increase of 1,583,494 ounces) regained first place from Arizona. Arizona was second with 6,598,986 ounces, compared with 5,885,625 ounces in 1928. Utah was again third with 1,608,570 ounces, compared with 1,275,682 ounces in 1928. These three States yielded 86 per cent of the total silver recovered from copper ore in 1929.

The production of Arizona comes mainly from Bisbee and Jerome, that of Montana mainly from Butte, that of Utah mainly from Bingham, and that of California mainly from Plumas County. Of these districts Bisbee well represents the disseminated type, Bingham produces from both lode and disseminated deposits, and the remainder produce silver chiefly from copper ore mined from deep lodes. Some silver is also produced in leaching copper ore.

LEAD ORE

The mine production of silver from argentiferous lead ore was 1,717,166 ounces less in 1929 than in 1928. The large increases were in Colorado (99,758 ounces), Idaho (82,941 ounces), and California (21,198 ounces). The large decreases were in Utah (960,373 ounces), Nevada (921,985 ounces), Montana (15,220 ounces), and Arizona (13,555 ounces). Idaho and Utah mines yielded 85 per cent of the silver from lead ore in 1929.

Most of the output is obtained from the desilverization of lead bullion from the smelting of western concentrates. The largest producers of silver-lead ore are the mines in the Park City and Tintic districts in Utah and in the Coeur d'Alene region in Idaho; several hundred mines in many other districts contribute varying quantities of silver from silver-lead ore.

LEAD-ZINC ORE

The output of silver from lead-zinc ore decreased from 16,210,430 ounces in 1928 to 15,645,050 ounces in 1929. The largest producer of silver from lead-zinc ore was Utah with 7,912,883 ounces. Other large contributors were Idaho, with 2,590,083 ounces; Montana, with 2,327,493 ounces; Colorado, with 1,176,413 ounces; New Mexico, with 733,146 ounces; and Nevada, with 675,679 ounces. The lead-zinc ores in the Eastern and Central States contain no appreciable quantity of silver.

ZINC AND MIXED ORES

None of the zinc ore treated in States east of Colorado yielded any gold or silver, and the mine production of silver from zinc ore was almost entirely credited to Montana mines in 1929. More silver from

Montana was designated as coming from zinc ore and less from lead-zinc ore in 1929 than in 1928. Silver from copper-lead and copper-lead-zinc ores increased from 2,207,200 ounces in 1928 to 2,836,912 ounces in 1929; 71 per cent of this output was derived from mines in Idaho and 17 per cent from mines in Nevada. The only other large producers of silver from these classes of ore were mines in Arizona, Montana, New Mexico, and Utah. The silver content of the copper-lead and copper-lead-zinc ores treated averaged 6.3 ounces a ton in 1928 and 10.9 ounces a ton in 1929.

GOLD AND SILVER, BY METHODS OF TREATMENT

The following table gives the production of gold and silver from ore, old tailings, etc., treated in 1928 and 1929.

Gold and silver produced in the United States from ore, old tailings, etc., in 1929, by States and by methods of recovery[1]

State	Total quantity of crude ore, old tailings, etc., treated (short tons)	Ore, old tailings, etc., to gold and silver mills				Ore and old tailings to concentrating mills (short tons)	Concentrates from all sources			Crude ore to smelters			Ore leached, old tailings and slag smelted, etc.		
		Ore (short tons)	Old tailings, etc. (short tons)	Gold in bullion (fine ounces)	Silver in bullion (fine ounces)		Short tons	Gold (fine ounces)	Silver (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)
Alaska	4, 490, 400	3, 899, 129		[2] 136, 497	[2] 21, 578	582, 947	63, 286	39, 031	344, 602	8, 324	750	79, 920			
Arizona	25, 860, 772	9, 162	80	6, 877	17, 206	18, 235, 758	1, 056, 821	48, 817	2, 124, 957	3, 266, 575	145, 526	5, 352, 804	4, 349, 197	825	48, 274
California	1, 657, 069	[3] 505, 471	28, 468	[4] 179, 095	[4] 47, 138	993, 387	69, 127	41, 444	782, 351	41, 386	4, 433	332, 931	[5] 88, 357	266	1, 163
Colorado	1, 172, 193	378, 056	([6])	152, 863	52, 959	692, 664	133, 220	37, 754	2, 418, 481	101, 473	20, 855	1, 925, 389			
Idaho	2, 174, 125	25, 797		11, 644	7, 614	2, 100, 734	345, 090	3, 178	8, 625, 085	47, 557	1, 288	779, 971	37	7	314
Montana	4, 723, 445	19, 192	803	4, 620	19, 595	4, 440, 764	771, 392	44, 032	11, 217, 108	128, 350	5, 279	1, 404, 317	134, 336	230	75, 886
Nevada	7, 355, 500	229, 923	282, 820	79, 839	2, 446, 032	6, 609, 780	414, 346	66, 026	1, 676, 793	232, 057	15, 447	784, 196	920	283	15, 480
New Mexico	4, 506, 807					4, 350, 301	258, 078	22, 901	832, 618	156, 506	12, 196	288, 924			
Oregon	10, 509	2, 514	100	2, 633	1, 006	4, 035	292	1, 604	20, 087	3, 860	908	7, 138			
South Dakota	1, 463, 159	1, 463, 159	([7])	316, 837	85, 182										
Texas	63, 872	54, 644		775	674, 152		1, 011	504	299, 897	9, 228		46, 467			
Utah	19, 831, 975	2		40	15	19, 211, 775	853, 052	166, 439	10, 454, 047	558, 867	70, 745	6, 879, 735	61, 331	3, 150	258, 584
Washington	93, 527	4, 695		2, 677	143	87, 415	5, 013	180	21, 679	1, 417	567	25, 262			
Wyoming	143	115		48	7					28		19			
Eastern States	[8] 2, 222, 334	3, 010		43	12	[9] 1, 781, 322	[9] 50, 660	1, 145	53, 037	[9] 438, 002	436	58, 598			
	75, 625, 830	6, 594, 869	312, 271	894, 488	3, 372, 639	59, 090, 882	4, 021, 388	473, 055	38, 870, 742	4, 993, 630	278, 430	17, 965, 671	4, 634, 178	4, 761	399, 701
Total, 1928	69, 723, 695	[10] 6, 877,515	[10] 365,355	982, 177	4, 399, 343	53, 601, 807	3, 644, 149	482, 607	36, 401, 886	4, 606, 626	261, 656	16, 488, 125	4, 272, 392	4, 792	339, 674

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[1] Philippine Islands, Illinois, Michigan, and Missouri excluded. The Philippine Islands produced $3,320,300 in gold and 101,480 fine ounces of silver from about 235,000 tons of gold ore.

[2] Exclusive of bullion from 2,220 tons of concentrates amalgamated or cyanided, figures for which are included under "Concentrates from all sources."

[3] Also 3,795 tons of concentrates from California were cyanided and yielded 11,776.68 ounces of gold and 3,486 ounces of silver. The figures are included under "Concentrates from all sources."

[4] Includes 10,585.04 ounces of gold and 1,923 ounces of silver from pocket mining.

[5] Includes 87,818 tons of pyrites roasted for the manufacture of sulphuric acid; residue leached amounted to 59,737 tons.

[6] Sands and slimes (349,639 tons) from ore and concentrates first treated by amalgamation were cyanided.

[7] Sands and slimes (1,358,870 tons) from ore and concentrates first treated by amalgamation were cyanided.

[8] Includes low-grade pyritiferous magnetite ore from Pennsylvania; excludes ore containing no gold and silver.

[9] Includes only ore or concentrates that yielded gold and silver.

[10] Corrected figures.

The greatest output of ore, etc., was made in Arizona, Utah, Nevada, Montana, and New Mexico, all notable for large yields of copper ore; in Idaho, a large producer of lead ore and lead-zinc ore; in Alaska and California, large producers of both copper and siliceous ores; in Colorado, a large producer of siliceous and lead-zinc ores; and in South Dakota, a consistent large producer of siliceous ore.

The only large increases in ore sent direct to gold and silver mills in 1929 were in Alaska, Idaho, and South Dakota, and there were important decreases in Arizona, California, Colorado, Montana, Nevada, and Texas.

Many gold and silver mills employ concentrating apparatus, and the concentrates they obtain are combined in the preceding table with those from straight concentrating mills under the heading "Concentrates from all sources." The gold and silver included in this item are recovered partly by amalgamation (particularly in Alaska and California) and cyanidation, although most of the concentrates are smelted.

The figures for the quantity of ore treated by concentration include the large quantities of copper, lead, zinc, and mixed ores whose concentrates are smelted primarily for these metals, the gold and silver being recovered in refining the copper and lead bullion and smelting the zinc residues. The quantity of concentrates produced and the recoverable gold and silver content represent not only the concentrates from these straight concentrating mills but also the comparatively small quantity from gold and silver mills.

There were large decreases in 1929 in both gold and silver recovered at gold and silver mills. A few States, including Alaska and Idaho, showed an increase in gold, and there were large decreases in Arizona, California, Colorado, and Montana. The silver recovered at mills decreased more than 1,000,000 ounces. The States showing the largest decreases were California, Colorado, Nevada, and Texas.

Of the total quantity (59,090,882 tons) of ore containing gold or silver sent direct to concentrating plants in the United States in 1929, Utah contributed 19,211,775 tons and Arizona 18,235,758 tons—a total of about 63 per cent of all ore so treated. Most of the increase in the quantity of ore concentrated in 1929 was caused by the larger quantities of copper ore concentrated in these two States. Of the total gold recovered from concentrates, 68 per cent came from four States, as follows: Utah, 35 per cent; Nevada, 14 per cent; Arizona, 10 per cent; and Montana, 9 per cent. Other large producers of gold from concentrates were Alaska, California, Colorado, and New Mexico. Of the silver from concentrates, 29 per cent came from Montana, 27 per cent from Utah, and 22 per cent from Idaho; large quantities also came from Alaska, Arizona, California, Colorado, Nevada, New Mexico, and Texas. The total increase of more than 10 per cent in the quantity of ore directly concentrated was due to increases in the quantities milled in Arizona, California, Idaho, Montana, Nevada, New Mexico, Utah, Washington, and the Eastern States.

It is interesting to note the trend toward concentration in recent years. In 1919, 5.6 tons of crude ore was treated at concentrating plants for every ton of crude ore sent directly to smelters. In 1929, 12 tons of ore was concentrated for every ton of crude ore shipped to smelters, which indicates that the percentage of crude ore concentrated has practically doubled in the last 10 years.

No figures are available showing the quantity of gold and silver ores treated by flotation in 1929, but the increase, if any, was small and negligible compared with the immense tonnage of base ores so treated.

The figures for the quantity and the recoverable precious-metal content of crude ore shipped from the mines direct to the smelters include, in general, the richer gold, silver, copper, lead, and mixed ores from which the gold and silver are eventually recovered by refining the copper or lead bullion that collects the precious metals in the smelting. In 1929 Arizona produced 65 per cent and Utah 11 per cent of the ore directly smelted, and Utah and Arizona produced 78 per cent of the gold and 68 per cent of the silver recovered from crude ore smelted.

The old materials, mainly tailings and slags, re-treated (with which are included figures for ore and old tailings leached) are partly smelted, often for their fluxing as well as their metal value; considerable quantities of old tailings were concentrated and cyanided in 1929, and the impounding of mill tailings for future treatment, as well as because of legal requirements, has become a general practice. Most of the gold and silver derived from old tailings is included under recoveries by amalgamation and cyanidation at gold and silver mills.

Of the crude ore shipped direct to smelters (4,993,630 tons) in 1929 Arizona contributed 3,266,575 tons, mainly copper ore, yielding 52 per cent of the gold and 30 per cent of the silver recovered from ore directly smelted. Mines in Utah shipped to smelters 558,867 tons of crude ore, yielding 25 per cent of the gold and 38 per cent of the silver recovered by smelting crude ore. Most of the ore leached and old slag treated came from Arizona mines; other contributors of such materials were mines and old dumps in California, Montana, and Utah.

Gold and silver produced at mills in the United States and percentage of gold and silver recovered by smelting and from placers, 1920–1929 [1]

Year	Ore, old tailings, etc., treated (short tons)	Bullion recovered from all sources (fine ounces)			
		Amalgamation		Cyanidation	
		Gold	Silver	Gold	Silver
1920	7,560,043	679,409	228,807	580,205	7,582,358
1921	7,429,125	765,397	207,877	559,352	7,414,275
1922	7,442,998	812,396	183,119	541,318	8,803,787
1923	7,657,613	683,274	179,527	607,415	10,044,388
1924	8,023,899	746,777	231,742	563,208	8,921,688
1925	8,022,807	753,313	214,790	476,599	6,360,571
1926	7,948,788	682,345	184,640	455,640	5,173,664
1927	7,741,562	649,044	195,895	377,833	4,177,848
1928	7,242,870	[2] 675,222	[2] 211,633	[2] 374,900	[2] 4,256,989
1929	6,907,140	619,776	218,642	324,819	3,229,206

[1] Philippine Islands and Porto Rico excluded.
[2] Corrected figures.

Gold and silver produced at mills in the United States and percentage of gold and silver recovered by smelting and from placers, 1920–1929—Continued

Year	Percentage of gold and silver from all sources							
	Amalgamation		Cyanidation		Placers		Smelting[3]	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1920	28.5	0.4	24.3	13.4	25.3	0.13	21.9	86.1
1921	32.6	.45	23.9	16.0	28.9	.18	14.6	83.4
1922	35.4	.3	23.6	14.4	23.5	.1	17.5	85.2
1923	28.4	.3	25.3	14.3	22.9	.1	23.4	85.3
1924	30.6	.4	23.0	13.9	18.4	.1	28.0	85.6
1925	32.6	.3	20.7	9.5	18.9	.1	27.8	90.1
1926	30.6	.3	20.4	8.3	20.5	.1	28.5	91.3
1927	30.8	.3	17.9	7.0	21.4	.1	29.9	92.6
1928	[2]31.4	.4	[2]17.5	[2]7.4	19.4	.1	31.7	[2]92.1
1929	30.1	.4	15.8	5.3	19.8	.1	34.3	94.2

[2] Corrected figures.
[3] Both crude ores and concentrates.

About 19.8 per cent of the total gold output in 1929 came from placers; the percentage of the output of silver credited to the placers is insignificant. California, Colorado, Nevada, and South Dakota yielded the larger part of the gold recovered by cyanidation; the decrease in the quantity of gold recovered by this method in 1929 was due mainly to declines in Alaska, Arizona, California, Colorado, and Montana. The only States showing increases were Nevada, South Dakota, and Texas.

The gold recovered by amalgamation decreased 55,446 ounces in 1929. The largest decreases were in California, Colorado, Montana, Nevada, New Mexico, South Dakota, and Washington. Good increases were shown in Alaska and Idaho. The quantity of gold and silver recovered by amalgamation and cyanidation decreased considerably in 1929, whereas that recovered from ores and concentrates smelted increased.

A large quantity of concentrates from sulphide ores is now smelted, and the increased application of the flotation process to base ores has resulted in more concentrates being shipped to smelters. The smelters are credited in 1929 with 34.3 per cent of the total output of gold and 94.2 per cent of the silver, compared with 31.7 per cent of the gold and 92.1 per cent of the silver in 1928.

The bulk of the gold produced continues to come from the gold mills, although the proportion of gold so recovered in 1929 was only 45.9 per cent of the total, compared with 60 per cent in 1919.

Gold and silver bullion produced at mills, 1928 and 1929, by States [1]

State	Ore, old tailings, etc., treated (short tons)	Bullion recovered from all sources (fine ounces)				Percentage of gold and silver from all sources in State			
		Amalgamation		Cyanidation		Amalgamation		Cyanidation	
		Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1928									
Alaska	[2]3,733,417	166,067	80,113	1,140	100	50.2	17.6	0.3	------
Arizona	32,390	533	276	13,890	20,103	.3	------	7.2	0.3
California	[2]729,332	[3]211,478	[3]48,902	[3]46,895	[3]299,047	[3]40.5	[3]3.3	[3]9.0	[3]20.2
Colorado	[4]630,718	56,781	14,964	127,592	196,706	22.1	.4	49.7	4.9
Idaho	10,054	8,459	3,277	2	206	40.3	------	------	------
Montana	64,643	4,397	2,868	6,799	12,297	7.6	------	11.7	.1
Nevada	551,148	8,311	8,477	72,756	2,720,994	4.7	.2	41.5	49.6
New Mexico	3,000	873	140	------	------	2.7	------	------	------
Oregon	3,369	2,767	728	------	------	25.3	2.4	------	------
South Dakota	[5]1,422,138	211,921	51,649	105,445	37,421	66.8	57.0	33.2	41.3
Texas	57,475	------	------	381	970,115	------	------	77.9	72.4
Utah	5	10	3	------	------	------	------	------	------
Washington	4,881	3,538	203	------	------	21.7	.2	------	------
Wyoming	100	33	17	------	------	100.0	32.1	------	------
Eastern States	200	54	16	------	------	3.2	------	------	------
	7,242,870	[3]675,222	[3]211,633	[3]374,900	[3]4,256,989	[3]31.4	.4	[3]17.5	[3]7.4
Value	------	[3]$13,958,078	[3]$123,805	[3]$7,749,871	[3]$2,490,339	------	------	------	------
1929									
Alaska	[2]3,899,129	174,827	93,301	------	------	46.6	19.7	------	------
Arizona	9,242	441	3,143	6,436	14,063	.2	------	3.2	.2
California	[2]533,939	160,053	40,061	30,819	10,563	38.8	3.4	7.5	.9
Colorado	[4]378,056	48,714	7,378	104,149	45,581	22.8	.2	48.7	1.0
Georgia	130	31	8	------	------	24.9	50.0	------	------
Idaho	25,797	11,634	7,603	10	11	57.5	.1	------	------
Montana	19,995	1,629	1,074	2,991	18,521	3.0	------	5.5	.1
Nevada	512,743	6,182	13,259	73,657	2,432,773	3.8	.3	45.0	49.4
North Carolina	2,880	12	4	------	------	4.9	------	------	------
Oregon	2,614	2,619	970	14	36	15.3	3.2	.1	.1
South Dakota	[5]1,463,159	210,869	51,676	105,968	33,506	66.6	60.7	33.4	39.3
Texas	54,644	------	------	775	674,152	------	------	60.6	66.1
Utah	2	40	15	------	------	------	------	------	------
Washington	4,695	2,677	143	------	------	72.0	.3	------	------
Wyoming	115	48	7	------	------	100.0	26.9	------	------
	6,907,140	619,776	218,642	324,819	3,229,206	30.1	.36	15.8	5.3
Value	------	$12,811,907	$116,536	$6,714,605	$1,721,167	------	------	------	------

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[1] Philippine Islands excluded.

[2] Also concentrates treated in gold and silver mills; metal content included under "Bullion recovered from all sources." For details see p. 904.

[3] Corrected figures.

[4] Also 313,127 tons in 1928 and 349,639 tons in 1929 of sands and slimes from ore and concentrates amalgamated were treated by cyanidation.

[5] Also 1,371,096 tons in 1928 and 1,358,870 tons in 1929 of sands and slimes from ore amalgamated were treated by cyanidation.

The great bulk of the ore treated in gold and silver mills was from Alaska, South Dakota, California, Colorado, and Nevada, and here the famous mines and mills of the Homestake, Mother Lode, Grass Valley, Treadwell, Cripple Creek, Tonopah, and Goldfield districts are especially noteworthy. Large numbers of smaller mills, however, mark the wide distribution of gold mining in these regions and in many other scattered districts.

The total yield of gold by amalgamation in the United States, as reported to the bureau by the mines, in 1929 was 619,776 ounces, compared with 675,222 ounces in 1928 and 1,120,344 ounces in 1911, the first year for which figures are available. The output of gold by cyanidation in 1929 was 324,819 ounces, compared with 374,900 ounces in 1928 and 1,444,077 ounces in 1915, the year of largest recorded output. From this it will be noted that the decrease in gold recovered by cyanidation has been at a much larger rate than the decrease by amalgamation. The output of silver by cyanidation decreased from 4,256,989 ounces in 1928 to 3,229,206 ounces in 1929. Nevada mines yielded about 75 per cent of the total and Texas 21 per cent, although both States showed a large decrease in silver by this method of recovery in 1929.

Mines in Alaska, California, Idaho, Oregon, South Dakota, and Washington yielded more gold by amalgamation than by cyanidation, but cyanidation produced more gold than amalgamation in Arizona, Colorado, Montana, Nevada, and Texas. In Alaska, California, Idaho, Oregon, South Dakota, and Washington the recovery of silver by amalgamation exceeded that by cyanidation. In 1929 amalgamation produced gold and silver valued together at $12,928,443, compared with $8,435,772 produced by cyanidation.

QUICKSILVER AND CYANIDE USED

Figures showing the total quantity of quicksilver and cyanide used in the recovery of gold and silver in the United States in 1929 are not available. For details of the use of quicksilver in the amalgamation milling process and of cyanide in the cyanidation process the reader is referred to the mine reports for the several Western States.

A considerable quantity of quicksilver was used at gold dredges in Alaska, California, Colorado, Idaho, and Oregon and at placer mines operated by hydraulicking and sluicing. The following quantities of quicksilver were purchased for use at gold and silver mills in the States for which figures are available: Arizona, 164 pounds; Colorado, 1,373 pounds; Idaho, 1,011 pounds; Montana, 280 pounds; Nevada, 800 pounds; South Dakota, 9,225 pounds; and Washington, 75 pounds.

Considerable cyanide is used at flotation mills as well as at gold and silver mills. Cyanide used at gold and silver mills in 1929 was mainly sodium cyanide; some cyanamid and a very small quantity of potassium cyanide were also used. Reduced to the equivalent of 96 to 98 per cent NaCN, the following data indicate amounts used at mines in the States for which figures are available: Arizona, 20,000 pounds; Colorado, 297,025 pounds; Montana, 15,664 pounds; Nevada, 848,273 pounds; South Dakota, 353,859 pounds; and Texas, 133,000 pounds. No cyanide was reported as consumed in Alaska, Idaho, New Mexico, Utah, Washington, or Wyoming. The following table gives details of the use of cyanide in eight Western States during the last five years.

Potassium and sodium cyanide consumed at mills in eight Western States, 1925–1929

State and year	Number of mills using cyanidation process	Ore and old tailings treated (short tons)	Cyanide consumed (pounds)[1]		
			Total	Per ton of ore and old tailings	Per ounce of gold and silver
Arizona:					
1925	6	59,840	84,600	1.41	1.66
1926	10	96,545	90,315	.94	1.03
1927	9	102,932	92,815	.90	1.47
1928	5	30,948	34,710	1.12	1.02
1929	3	8,364	20,000	2.39	.975
Colorado:					
1925	3	463,922	309,293	.67	1.75
1926	3	508,060	258,327	.51	1.49
1927	2	501,011	270,000	.54	1.19
1928	2	462,153	384,351	.83	3.01
1929	2	339,463	297,025	.87	1.98
Idaho:[2]					
1925	1	1,377	3,900	2.83	3.96
1927	1	23	(3)	------------	------------
Montana:					
1925	6	42,572	54,684	1.28	.57
1926	6	22,205	43,000	1.94	.64
1927	4	21,730	36,308	1.67	1.08
1928	5	47,637	73,728	1.55	3.86
1929	3	11,738	15,664	1.334	.728
Nevada:					
1925	16	801,141	2,123,687	2.65	.41
1926	15	717,582	1,787,957	2.49	.41
1927	22	446,869	1,105,600	2.47	.36
1928	18	527,511	776,570	1.47	.28
1929	15	490,650	848,273	1.73	.34
New Mexico:[4]					
1925	1	52,118	81,159	1.56	.18
1926	1	750	1,125	1.50	.16
South Dakota:					
1925	3	1,567,555	347,242	.22	2.79
1926	3	1,402,472	299,672	.21	2.35
1927	3	1,353,298	312,626	.23	2.03
1928	3	1,376,205	335,675	.24	3.18
1929	1	1,384,094	353,859	.26	2.54
Texas:					
1925	1	72,685	43,691	.60	.08
1926	1	33,818	24,375	.72	.06
1927	1	48,190	96,813	2.01	.12
1928	1	57,475	163,000	2.84	.17
1929	1	54,644	133,000	2.43	.20

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[1] Partly estimated for Arizona, Idaho, Montana, and Nevada.
[2] No consumption reported for 1926, 1928, and 1929.
[3] Quantity small; figures not available.
[4] No consumption reported for 1927, 1928, and 1929.

REVIEW BY STATES

ALASKA

Gold.—The total estimated production of gold from Alaska mines from 1880 to 1929, inclusive, is given by the United States Geological Survey as $380,841,000. The mine production in 1929 was $7,761,000, or $916,000 more than in 1928. The yield from lode mines increased from $3,498,000 in 1928 to $3,644,000 in 1929, and that from placer mines increased from $3,347,000 in 1928 to $4,117,000 in 1929. The 30 dredges operated produced $2,932,000 of the placer output—$747,000 more than 26 dredges produced in 1928. The increased output from dredges was due to the operation of new dredges in the Fairbanks district. The average recovery of gold by the dredges in 1929 was about 33.6 cents per cubic yard of gravel, compared with 34 cents in 1928. The 3,900,000 tons of siliceous ore treated in 1929 yielded an average of $0.95 in gold and silver to the ton, the same as in 1928. In 1929 about 47 per cent of the total gold came from siliceous ore, compared with 51 per cent in 1928. The estimated recovery of gold from dredges for the period 1903 to the end of 1929 is $39,007,474.

Silver.—The mine production of silver in Alaska in 1929 was 472,900 fine ounces. Copper ore yielded 351,730 ounces, siliceous ore 94,370 ounces, and placer bullion 26,800 ounces. Most of the silver from Alaska mines is contained in concentrates recovered from copper ore. There was little difference between the recovery from this source in 1929 and that in 1928. Bullion from Alaska mills and from placers is unusually high in gold content, so that comparatively small quantities of silver are derived from refining bullion.

ARIZONA

Gold.—The production of gold from Arizona mines in 1929 was $4,182,287, of which only $5,652 was from placer mines. Of the production from lode mines ($4,176,635) 8 per cent was from dry and siliceous ores, 89 per cent from copper ore, and 3 per cent from other classes of ore. Yavapai County had an output of $1,693,404 in gold and Cochise County $1,461,427. None of the other counties produced as much as $311,000. The gold recovered from ore and old tailings by amalgamation and cyanidation was valued at $142,160, about $155,989 less than in 1928. The gold recovered from concentrates was valued at $1,009,135; gold from crude ore shipped to smelters was valued at $3,008,295, an increase of $383,542 over that recovered in 1928. The crude copper ore directly smelted amounted to 3,165,287 tons and yielded an average of about 90 cents in gold a ton.

Silver.—Of the mine production of silver in Arizona in 1929 (7,543,283 ounces) 6,598,986 ounces came from copper ore, 403,508 ounces from siliceous ore, 249,575 ounces from lead ore, 225,581 ounces from lead-zinc ore, and 65,633 ounces from other ores and from placer bullion. Yavapai County produced 2,810,859 ounces, Cochise County 2,416,945 ounces, and Pinal County 1,240,771 ounces, all mainly from copper ore. None of the other counties yielded as much as 330,000 ounces. Silver recovered by cyanidation and amalgamation amounted to 17,206 ounces, concentrates yielded 2,124,957 ounces (an increase of about 238,600 ounces), and crude ore shipped to smelters yielded 5,352,804 ounces (480,948 ounces more than in 1928). Crude copper ore shipped directly to smelters yielded 1.52 ounces of silver a ton.

ARKANSAS, MISSOURI, OKLAHOMA, ILLINOIS, AND KENTUCKY

The lead and zinc mines of the Central States produce no gold and only a small quantity of silver, although the quantity of crude ore treated yearly normally exceeds 10,000,000 tons. None of the zinc ores of Illinois, Kansas, Oklahoma, Missouri, or Wisconsin yield silver, although they occasionally show traces in assays. Occasional small shipments of copper ore from Missouri mines yield some silver, but no copper ore was shipped in 1929. The silver from southeastern Missouri mines in 1929 (181,638 ounces) was all derived from lead ore. A small part of it was recovered in refining lead bullion, but most of it was contained in zinc flotation concentrates derived from lead ore.

The zinc concentrates were treated first at retort zinc smelters, and the residues containing the silver were treated at lead smelters. The zinc concentrates from the lead ores of southeastern Missouri have a high silver content, whereas the lead concentrates smelted contain almost no silver. The lead-fluorspar ores of Illinois carry silver; 3,700 ounces of silver were reported from this source in 1929 and were recovered from 668 tons of lead concentrates. There have been some scattered recoveries of silver from mines in Arkansas and Oklahoma, but no recoveries were reported in 1928 or 1929.

CALIFORNIA

Gold.—The total production of gold from California mines from 1848 to 1929, inclusive, is recorded as $1,832,089,063, of which $1,230,786,011 was from placer mines. In 1929 the total value of the production of gold from mines in California was $8,526,703, compared with $10,785,315 in 1928. The lode mines produced $4,656,096, or 22 per cent less than in 1928. Of the 1929 output from lode mines, 90 per cent came from dry and siliceous ores and 9 per cent from copper ore. The total output of the placer mines in 1929 was $3,870,607, or 20 per cent less than in 1928; of the placer-gold output $3,589,259 was recovered by 25 dredges, or $841,654 less than in 1928. The total production of gold from dredges from 1896 to the end of 1929 was $163,553,943. Seven Yuba County dredges made the largest output, $1,441,650, over $2,000,000 less than 7 dredges yielded in 1927. Eight dredges in Sacramento County produced $1,481,594. The output of the once very productive dredging industry in Butte County was only $45,340. Dredges in Trinity County produced $310,297. Five dredges—one each in Amador, Calaveras, Merced, Shasta, and Stanislaus Counties—yielded $310,378. For the last 10 years four counties—Amador, Nevada, Sacramento, and Yuba—have each produced annually more than $1,000,000 in gold. Of these, Amador and Nevada recovered most of their output from siliceous gold ore, and Yuba and Sacramento usually obtained nearly all their output from gold dredges. The five Mother Lode counties—Amador, Calaveras, Eldorado, Mariposa, and Tuolumne—whose output is mainly gold milling ore, produced 69,095 ounces of gold from mill bullion and 14,877 ounces from concentrates derived from gold ore; the average value in gold and silver from the 230,389 tons of ore milled in 1929 was $7.58 compared with $7.76 in 1928. Nearly 88 per cent of the gold derived from copper ore (20,041 ounces) was from copper mines in Plumas County, and none of the other counties yielded as much as 1,000 ounces of gold from copper ore.

Silver.—The total output of silver from California mines from 1848 to 1929, inclusive, is recorded as 82,913,947 fine ounces, valued at $70,264,857. The total production of silver from California mines in 1929 was 1,176,895 ounces, a decrease of 301,876 ounces from that of 1928. Copper ore and tailings yielded 547,183 ounces, dry and siliceous ore 554,893 ounces, lead and lead-copper ores 61,507 ounces, and placer bullion 13,312 ounces. The only counties whose mines yielded more than 100,000 ounces of silver were Plumas (408,466 ounces), San Bernardino (356,015 ounces), and Napa (144,180 ounces). Concentrates smelted yielded 778,865 ounces of silver and crude ores smelted 332,931 ounces. Only 48,701 ounces of silver was recovered from ore amalgamated, ore and tailings (sands and slimes) cyanided, and concentrates cyanided.

COLORADO

The total production of gold in Colorado from 1858 to 1929, inclusive, is estimated at $710,000,000 and that of silver at 653,000,000 ounces.

Gold.—The production of gold from Colorado mines in 1929 was $4,417,358, a decrease of $887,518 compared with 1928. The siliceous ores of the Cripple Creek district in Teller County yielded $2,640,034; that part of the San Juan region including Dolores, La Plata, Ouray, Rio Grande, San Juan, and San Miguel Counties yielded $1,038,217; Park County $206,797; and Lake County $138,031. The gold recovered at placer mines was $45,850 in 1929, or about one-fourth less than in 1928; a dredge in Summit County produced most of the placer gold. Dry gold ore from Colorado yielded $3,634,594, dry gold and silver ore $320,744, dry silver ore $36,790, copper ore $61,493, lead ore $47,289, and zinc-lead and copper-lead ores $270,598. The quantity of gold recovered by cyanidation and amalgamation was 152,863 ounces, that contained in concentrates was 37,754 ounces, and that in crude ore shipped to smelters was 20,855 ounces.

Silver.—The output of silver from Colorado mines in 1929 was 4,397,377 ounces, or 345,124 ounces more than in 1928. Of this output mines in the San Juan region, including Mineral and Saguache Counties, yielded 2,716,846 ounces; those in Eagle County 917,171 ounces; and those in Lake County 394,270 ounces. The sources of the silver were as follows: Dry and siliceous ores, 2,098,226 ounces; copper ore, 784,933 ounces; lead ore, 333,369 ounces; and zinc-lead and copper-lead ores, 1,180,301 ounces. Only 52,959 ounces of silver was recovered in bullion at gold and silver mills and 1,925,389 ounces from crude ore shipped to smelters. Most of the silver was derived from concentrates from San Juan, Saguache, Lake, and Dolores Counties.

IDAHO

The total gold production of Idaho from the discovery of placer gold in 1863 to the end of 1929 is estimated at $137,066,890 and the total output of silver for the same period at 317,027,379 ounces.

Gold.—Of the total output of gold from Idaho mines in 1929, valued at $418,545, Boise County produced $259,754, or about $26,300 more than in 1928. The value of the placer gold, $85,373, was about $84,000 less than in 1928. Three dredges produced $60,143 of the total gold derived from placers in 1929. The total value of gold recovered by dredges from 1897 to 1929, inclusive, was $6,087,075. The value of the gold from lode mines in 1929 was $333,172, an increase of $68,805 over that in 1928. Of the total gold in 1929, 20 per cent came from placers, 63 per cent from dry and siliceous ores, 12 per cent from copper ore, and 5 per cent from other classes of ore. About 72 per cent of the gold from lode mines was recovered by amalgamation.

Silver.—Of the 1929 output of silver (9,414,403 ounces) 8,776,726 ounces was from the Coeur d'Alene region in Shoshone County. The only other counties that produced more than 180,000 ounces of silver were Blaine and Custer. Lead ore yielded 50 per cent of the silver in 1929, lead-zinc ore 28 per cent, and copper-lead ore 21 per cent. Other ores and placer bullion yielded only about 1 per cent. Very little silver was obtained from placer and mill bullion; concentrates shipped yielded 8,625,085 ounces and crude ore sent direct to smelters 779,971 ounces.

MICHIGAN

The copper mines of Michigan produced 20,795 ounces of silver in 1929, or 3,642 ounces more than in 1928. Some of the silver was obtained from lumps of native silver picked from copper ore mined; the remainder was derived from the electrolytic refining of copper. The silver credited to Michigan has declined greatly in recent years.

MONTANA

The total production of gold from Montana from 1904 to 1929, inclusive, is recorded as $75,909,834 and the total production of silver for the same period as 325,110,585 ounces.

Gold.—The total production of gold from Montana mines in 1929 was $1,131,949, a decrease of $71,071 from that in 1928. No gold dredges were operated in Montana in 1929, and the output from placer mines declined from $17,884 in 1928 to $12,334 in 1929. The value of the gold from lode mines decreased from $1,185,136 in 1928 to $1,119,615 in 1929. Silver Bow County produced $538,688 of the total gold, Lewis and Clark County $259,605, and Madison County $208,109. None of the other counties produced as much as $40,000 in gold. Copper ore yielded $641,466 in gold, siliceous ore $350,883, and lead-zinc ore $81,139; all other ores combined produced less than $50,000 in gold. At amalgamation and cyanidation plants 4,620 ounces of gold was recovered, less than half the recovery from this source in 1928. Concentrates from all sources yielded 44,032 ounces of gold (two-thirds from copper concentrates), and crude ore shipped to smelters 5,279 ounces.

Silver.—The total production of silver from Montana mines in 1929 (12,716,977 ounces) was 1,863,701 ounces more than in 1928, due mainly to the larger quantity of copper ore treated. Copper ore yielded 7,289,007 ounces of silver, or 57 per cent of the total. Lead-zinc ore yielded 2,327,493 ounces, zinc ore 1,576,332 ounces, and dry and siliceous ore 1,198,531 ounces; lead ore, copper-lead ore, and placers yielded the remainder. Silver Bow County produced 9,918,906 ounces, or about 360,000 ounces more than in 1928. Other large silver-producing counties in 1929 were Flathead, with 885,528 ounces; Granite, with 557,687 ounces; Judith Basin, with 784,186 ounces; Jefferson, with 180,062 ounces; and Cascade, with 157,503 ounces. Bullion from mills yielded only 19,595 ounces and crude ore smelted only 1,404,317 ounces. The bulk of the silver from Montana in 1929 was derived from concentrates smelted or sent to electrolytic plants; the total recovery from concentrates was 11,217,108 ounces, and the average recovery was 14.5 ounces of silver a ton.

NEVADA

The total production of gold from Nevada from 1904 to 1929, inclusive, is recorded as $209,211,477 and the total silver production as 245,996,850 ounces.

Gold.—The production of gold from Nevada mines in 1929 was $3,384,211; of this only $43,762 was from placer mines (no gold dredges were operated in 1929). The total value of the gold recovered decreased $236,622 in 1929. The larger producing counties were White Pine County, which produced 39 per cent of the total gold, Elko County 21 per cent, Nye County 15 per cent, and Esmeralda County about 14 per cent. The gold from White Pine County ($1,330,861) decreased $119,352 in 1929 and was nearly all derived from copper ore; that from Nye, Esmeralda, and Elko Counties was mainly from siliceous ores. The gold derived from siliceous ore in 1929 amounted to 90,656 ounces, that from copper ore to 65,288 ounces, and that from lead and lead-zinc ores to 4,924 ounces. Copper ore yielded 40 per cent of the gold in 1929, compared with 39 per cent in 1928.

Silver.—The mine production of silver in Nevada in 1929 was 4,923,526 ounces, or 558,048 ounces less than in 1928. Nye County produced 1,713,229 ounces of silver, Lincoln County 852,241 ounces, Esmeralda County 774,131 ounces, and Eureka County 521,610 ounces. Storey County (Comstock) yielded only 32,399 ounces of silver in 1929. The Tonopah district in Esmeralda and Nye Counties produced 1,965,595 ounces of silver in 1929. Dry and siliceous ore yielded 57 per cent of the silver, lead and copper-lead ores 24 per cent, and zinc and lead-zinc ores 14 per cent. About 49 per cent of the silver was recovered by cyanidation, 34 per cent from concentrates, and 16 per cent from crude ore shipped to smelters.

NEW MEXICO

Gold.—The gold produced by mines in New Mexico in 1929 was $727,162, or $46,802 more than in 1928. San Miguel County was the largest producer, yielding 47 per cent of the gold; Hidalgo County yielded 30 per cent; and Grant County 19 per cent. Lead-zinc ores, largely from the Pecos mine near Glorieta, yielded 47 per cent of the gold; copper ore yielded 49 per cent; and dry and siliceous ores only 3 per cent. The Aztec gold mine in Colfax County was idle in 1929. Placer mines produced about 80 ounces of gold. The Pecos mine and the Chino copper mine were the largest producers of gold. Concentrates yielded 22,901 ounces of gold and crude ore shipped to smelters 12,196 ounces.

Silver.—The mine production of silver in New Mexico increased from 827,793 ounces in 1928 to 1,121,546 ounces in 1929. Copper ore yielded 24 per cent of the silver, lead-zinc ore 65 per cent, siliceous ores nearly 5 per cent, lead ore 4 per cent, and copper-lead ore nearly 2 per cent. San Miguel County produced 42 per cent of the silver, Grant County 35 per cent, Hidalgo County 15 per cent, and Catron County 4 per cent. Most of the silver (77 per cent) was from concentrates derived from copper ore and lead-zinc ore.

OREGON

Gold.—The production of gold from Oregon mines in 1929 was $353,323, or $127,355 more than in 1928, and was the largest since 1925. The output from lode mines ($106,354) was only $911 more than in 1928. Of the gold from lode mines the Eastern district contributed $38,742 and the Western district $67,612. The only increase was in the Western district. The production of the placer mines in 1929 was $246,969, or more than double that in 1928. Placer mines in the Western district contributed $184,555, an increase of $114,035, whereas the output from placer mines in the Eastern district increased only $12,409. Of the placer gold, three dredges—one each in Baker, Grant, and Jackson Counties—recovered gold valued at $205,464. Copper ore (3,836 tons) yielded 235 ounces of gold, dry and siliceous ore 4,910 ounces, and placer bullion 11,947 ounces. Ore amalgamated yielded 2,620 ounces of gold, tailings cyanided 14 ounces, and ore and concentrates smelted 2,511 ounces.

Silver.—Of the total mine production of silver (30,009 ounces) in Oregon in 1929, 21,341 ounces came from siliceous ore, 6,890 ounces from copper ore, and 1,778 ounces from placer bullion; the total output was 915 ounces less than in 1928. More than two-thirds of the silver was from mines operated in Grant County. Only 1,006 ounces of silver was recovered by amalgamation and cyanidation; 20,087 ounces was recovered from concentrates smelted and 7,138 ounces from crude ore shipped to smelters.

SOUTH DAKOTA

The total value of gold produced from mines in South Dakota from 1875 to 1929, inclusive, is recorded as $280,805,722 and the total output of silver for the same period as 7,664,828 ounces.

Gold.—The production of gold from South Dakota mines in 1929 was $6,549,599, or $11,206 less than in 1928. The output was derived entirely from low-grade siliceous ore. Nearly 67 per cent was recovered by amalgamation and the remainder by cyanidation. The Homestake mills treated 1,437,935 tons of ore from the Homestake mines and produced bullion worth $6,517,838. The ore reserves are estimated at 15,176,740 tons. The only other producing gold mine in South Dakota in 1929 was that of the Keystone Consolidated Mines Co. (Inc.), in Pennington County.

Silver.—The output of silver from South Dakota mines in 1929 was 85,182 ounces, derived entirely from bullion produced at mills.

SOUTHERN APPALACHIAN AND EASTERN STATES

Gold.—The total production of gold in the Southern Appalachian States from 1799 to 1929, inclusive, is recorded as $51,170,763. The data compiled credit Alabama with $766,949, Georgia with $17,847,658, Maryland with $71,405, North Carolina with $23,668,507, South Carolina with $5,182,815, Tennessee with $334,993, and Virginia with $3,298,436. The mine production of gold in the Southern Appalachian States in 1929 was $19,511, compared with $14,591 in 1928, of which Tennessee mines yielded $11,680 in gold, all from copper ore; 1 placer mine in Alabama $203; 5 placers and 2 lode mines in Georgia $2,574; and 3 placers and 3 lode mines in North Carolina $5,054. The remainder of the gold from mines in the Southern Appalachian and Eastern States was recovered from copper concentrates derived from pyritiferous magnetite ore mined at the Cornwall mine in Pennsylvania. About 3,010 tons of siliceous ore was treated in 1929; the recovery of gold per ton was small, partly because gold concentrates were held for future treatment.

Silver.—The mine production of silver in 1929 was 111,660 fine ounces, or 9,140 ounces more than in 1928. The increase was entirely due to the larger output of copper in 1929. Placer bullion and dry and siliceous ore produced only 25 ounces of silver. Copper ore from Tennessee mines yielded 81,281 ounces of silver, that from North Carolina 21,098 ounces, and that from Vermont 3,284 ounces. The copper concentrates derived from pyritiferous magnetite ore from Pennsylvania yielded 5,972 ounces of silver.

TEXAS

The total output of gold from Texas mines from 1885 to 1929, inclusive, is recorded as $91,425 and the output of silver for the same period as 22,383,284 ounces.

Gold.—The mine production of gold in Texas in 1929 was $26,439, an increase of more than $16,300 over 1928; it came from the Presidio mine of the American Metal Co. near Shafter.

Silver.—The mine production of silver in 1929 was 1,020,516 fine ounces, a decrease of about 320,000 ounces compared with that in 1928. Most of the silver (974,049 ounces) was recovered from siliceous silver ore treated by cyanidation and from lead concentrates shipped from the Presidio mine. This mine has been worked since 1883 and has produced 1,330,309 tons of ore with mill heads averaging about 17.9 ounces of silver a ton. About 9,230 tons of silver and copper-silver ore was shipped to smelters in 1929 from mines in the Alpine, Allamoore, and Sierra Blanca districts.

UTAH

The total output of gold from Utah mines from 1864 to 1929, inclusive, is recorded as $131,239,854 and the total output of silver for the same period as 564,054,789 ounces.

Gold.—In 1929 the mine production of gold, of which all but $956 came from lode mines, was $4,969,915, or $575,914 more than in 1928. Of the total in 1929 the Tintic district yielded $1,017,293 (an increase of $306,041), the Bingham or West Mountain district $3,328,035 (an increase of $417,153), and the Park City district $428,364.

More than 57 per cent of the Utah gold was derived from copper ore (54 per cent in 1928), nearly 16 per cent from lead-zinc ore, more than 11 per cent from lead ore, and nearly 15 per cent from siliceous ore. The recovery of gold from concentrates was 166,439 ounces (an increase of nearly 11,000 ounces) and that from crude ore shipped to smelters 70,745 ounces. Very little gold bullion was recovered at mills or from placer operations.

Silver.—The mine production of silver in Utah was 17,592,396 ounces, or about 519,500 ounces more than in 1928. The output of mines in Salt Lake County was 4,675,321 ounces, in Utah County 3,795,685 ounces, in Summit County 3,371,426 ounces, in Wasatch County 2,786,075 ounces, and in Juab County 2,496,199 ounces. The Tintic district produced 6,272,456 ounces, the Bingham district 4,644,955 ounces, and the Park City district 6,157,501 ounces. The Park City district yielded less silver than in 1928, whereas the output of the Bingham district increased more than 916,000 ounces and that of the Tintic district nearly 40,000 ounces. Lead-zinc ore yielded nearly 45 per cent of the silver in 1929 (41.6 per cent in 1928), lead ore yielded 30 per cent, siliceous ore yielded more than 15 per cent, and copper ore more than 9 per cent. Crude ore shipped to smelters yielded 6,879,735 ounces of silver and concentrates 10,454,047 ounces. The increase in quantity of silver was from concentrates treated.

WASHINGTON

The total production of gold in Washington from 1860 to the end of 1929 is recorded as $30,334,997 and the total production of silver as 9,251,864 ounces.

Gold.—The production of gold from Washington mines in 1929 was $76,898, or $260,269 less than in 1928, due largely to the decrease of more than $248,200 from mines in Ferry County. The largest county production ($55,274) in 1929 was from mines in Whatcom County, although they produced much less than in 1928. The mines at Republic in Ferry County yielded only $10,541. Kittitas County was the only other county that produced more than $5,000 in gold. About 87 per cent ($66,664) of all the gold was derived from dry and siliceous ores, $3,911 from copper ore, $6,114 from placer mines, and only $209 from lead and lead-zinc ores. Ores treated by amalgamation yielded 2,677 ounces, ores concentrated 180 ounces, and crude ore shipped to smelters 567 ounces.

Silver.—Of the mine production of silver (47,182 ounces) in 1929, 17,614 ounces was from Snohomish County and 22,598 ounces from Stevens County. Ferry County, which produced 65,198 ounces of silver in 1928, produced only 3,628 ounces in 1929. The silver produced in 1929 was derived as follows: Copper ore 32,377 ounces, siliceous ore 6,932 ounces, lead and lead-zinc ores 7,775 ounces, and placer bullion 98 ounces. Crude ore shipped to smelters yielded 25,262 ounces, concentrates treated yielded 21,679 ounces, and ore amalgamated yielded 143 ounces.

WYOMING

The total production of gold in Wyoming from 1867 to the end of 1929 is recorded as $1,240,496 and that of silver for the same period as 70,197 ounces.

The mine production of gold in 1929 was $995 and that of silver 26 ounces, all from the Atlantic City district in Fremont County.

PHILIPPINE ISLANDS

The output of gold in the Philippine Islands from 1907 to 1929, inclusive, was $28,595,195. The production during the last 10 years was as follows:

1920	$1,276,561	1925	$1,945,990
1921	1,313,096	1926	1,925,188
1922	1,526,400	1927	1,686,231
1923	1,686,327	1928	1,904,062
1924	1,651,796	1929	3,320,300

The gold recovered in 1929 came from about 235,000 tons of siliceous gold ore. No dredges or other placers were operated. The principal producing properties were those of the Benguet Consolidated

Mining Co., the Balatoc Mining Co., and the Itogon Mining Co. near Baguio and the Syndicate Mining Co., Geringer, Ashurst & Co., and Panigue Mines (Ltd.) near Aroroy. The largest part of the gold came from Baguio, where the Benguet and Balatoc mines yielded about $2,700,000. About $150,000 in bullion was produced from lode prospects where hand grinding and panning were utilized.

The mine production of silver in the Philippine Islands in 1929 was 101,480 ounces.

A paper written by Clyde M. Eye[7] and read at a meeting of the American Institute of Mining and Metallurgical Engineers in San Francisco, Calif., September 11, 1930, gives considerable interesting data regarding the lode gold mines near Baguio on the island of Luzon about 175 miles from Manila. The following information has been abstracted from the article.

At Antamok, 7 miles from Baguio, is the property of the Benguet Consolidated Mining Co., equipped for mining to a depth of 1,200 feet.

The Colbath drainage tunnel completed in 1928 serves to drain all mine water to the depth of 700 feet. Pumps have been installed to drain the 900 and 1,100 foot levels which will permit exploration of ore located by diamond drilling. The upper ore bodies are of the superficial bonanza type occurring in a brecciated zone between two overlapping faults. The average value of the ore reserves is about $15 a ton with a 3-year supply in sight (at the present rate of milling) not including any ore below the 600-foot level. The average cost of operations during recent months has been about $7 a ton, and the average extraction by the cyanide process is about 93 per cent of the value of the crude ore.

The Balatoc mine is 10 miles from Baguio and is connected to the cyanide mill by an aerial tram. The mill is handling 140 tons daily and making a recovery of about 90 per cent of the bullion. Active development was commenced when the Benguet Consolidated Mining Co. contracted to expend $300,000 on the property on condition that it receive 60 per cent of the Balatoc stock. In 1929 the more than 40,000 tons of ore milled averaged $28.36 a ton, yielding about $1,177,470, with total operating costs under $10 a ton. A large amount of work has been done for a comparatively small quantity of ore developed, but the high grade of the ore compensates for the expenditure. The question as to whether the Balatoc ore bodies persist at depth has not yet been demonstrated, but diamond drilling at points for several hundred feet below the present workings shows no decrease in the value of the ore.

Electric power is supplied for both the Benguet and Balatoc mines by several hydroelectric plants and by a 300-horsepower Diesel engine used during the dry season. The latest addition to the power system is a large plant on the Agno River about 8 miles from Antamok. This plant was expensive to construct, but its erection solved all the problems of a power supply for both the Benguet and Balatoc mines.

The only other producing mine in the district is that of the Itogon Mining Co. lying east of the Balatoc mine and equipped with a small mill installed several years ago. Active development has been undertaken, and if results are favorable a new mill will be erected on the Itogon River and an aerial tram built from the mine to the mill.

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[7] Eye, C. M., Development of the Benguet Mining District; Min. and Met., November, 1930, pp. 522–525.

The Headwaters mine near the Benguet is being reopened after being idle many years. The old mill was dismantled and a new one must be built if development is favorable.

Various claims, including the Hartwell, have been prospected by the Benguet Consolidated Mining Co. with rather disappointing results. The Hartwell had the first mill in the district, a 3-stamp mill built before 1903.

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GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO[1]

(MINE REPORT)

By Chas. W. Henderson

SUMMARY

The total calculated gross value of the recovered and estimated recoverable gold, silver, copper, lead, and zinc from gravels handled and ores mined in Colorado in 1929 showed a decrease of 7 per cent from the gross value in 1928, following a decrease of 3½ per cent in 1928 from the gross value in 1927. There was a decrease of 17 per cent in the value of gold, a decrease of 1 per cent in the value of silver, an increase of 27 per cent in the value of copper, a decrease of 1 per cent in the value of lead, and a decrease of 11 per cent in the value of zinc. There were 290 lode mines and 13 placers producing in 1929, compared with 336 lode mines and 23 placers in 1928, or a decrease of 46 lode mines and 10 placers.

The total recorded value of gold, silver, copper, lead, and zinc (in terms of recovered metals) produced from Colorado ores and gravels from 1858 to 1929, inclusive, is $1,639,991,874.[2]

The value of metal production herein reported has been calculated at the figures given in the table that follows. Gold is figured at the mint value for fine gold; that is, $20.671835 an ounce. The silver price from 1920 to 1922 is New York market price for domestic silver only; for 1923, average price under the Pittman Act, January 1 to June 2, for domestic silver, and average New York price for all silver after that period; for 1924 and later years, average New York price for bar silver. The copper, lead, and zinc prices are weighted averages, for each year, of all grades of primary metal sold by producers.

Prices of silver, copper, lead, and zinc, 1920–1929

Year	Silver	Copper	Lead	Zinc
	Per fine ounce	*Per pound*	*Per pound*	*Per pound*
1920	$1.09	$0.184	$0.080	$0.081
1921	1.00	.129	.045	.050
1922	1.00	.135	.055	.057
1923	.82	.147	.070	.068
1924	.67	.131	.080	.065
1925	$0.694	$0.142	$0.087	$0.076
1926	.624	.140	.080	.075
1927	.567	.131	.063	.064
1928	.585	.144	.058	.061
1929	.533	.176	.063	.066

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[1] Work on manuscript completed April, 1931.

[2] For details 1858 to 1923, see Henderson, Charles W., Mining in Colorado: U. S. Geol. Survey Prof. Paper 138, 1926, 263 pp.; for recapitulation by years 1858 to 1925, see Gold, Silver, Copper, Lead, and Zinc in Colorado: Mineral Resources of the United States, 1925, Pt. I, opp. p. 701.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1920–1929, in terms of recovered metals

Year	Mines producing			Ore sold or treated (short tons)	Gold			Silver (lode and placer)	
	Lode	Placer	Total		Lode	Placer	Total	Fine ounces	Value
1920	405	11	416	1, 571, 293	$7, 061, 731	$514, 588	$7, 576, 319	5, 409, 335	$5, 896, 175
1921	367	15	382	1, 281, 381	6, 490, 688	344, 640	6, 835, 328	5, 631, 657	5, 631, 657
1922	460	20	480	1, 412, 100	6, 017, 016	356, 403	6, 373, 419	5, 855, 911	5, 855, 911
1923	400	17	417	1, 569, 100	6, 227, 200	364, 429	6, 591, 629	5, 334, 488	4, 374, 280
1924	340	18	358	1, 514, 182	8, 174, 610	418, 506	8, 593, 116	3, 254, 370	2, 180, 428
1925	412	30	442	1, 745, 674	7, 076, 704	150, 318	7, 227, 022	4, 506, 940	3, 127, 816
1926	387	31	418	1, 839, 740	7, 031, 079	46, 954	7, 078, 033	4, 704, 122	2, 935, 372
1927	330	19	349	1, 606, 528	5, 184, 684	94, 434	5, 279, 118	3, 784, 605	2, 145, 871
1928	336	23	359	1, 426, 084	5, 243, 470	61, 406	5, 304, 876	4, 052, 253	2, 370, 568
1929	290	13	303	1, 172, 193	4, 371, 508	45, 850	4, 417, 358	4, 397, 377	2, 343, 802

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1920	4, 043, 734	$744, 047	46, 629, 788	$3, 730, 383	48, 790, 742	$3, 952, 050	$21, 898, 974
1921	4, 153, 442	535, 794	19, 660, 466	884, 721	2, 360, 000	118, 000	14, 005, 500
1922	3, 373, 454	455, 416	23, 477, 200	1, 291, 246	23, 258, 000	1, 325, 706	15, 301, 698
1923	4, 248, 109	624, 472	45, 698, 185	3, 198, 873	54, 152, 000	3, 682, 336	18, 471, 590
1924	2, 713, 219	355, 432	47, 557, 061	3, 804, 565	56, 727, 000	3, 687, 255	18, 620, 796
1925	2, 360, 500	335, 191	62, 966, 000	5, 478, 042	61, 621, 000	4, 683, 196	20, 851, 267
1926	3, 403, 850	476, 539	68, 987, 800	5, 519, 024	65, 000, 000	4, 875, 000	20, 883, 968
1927	5, 670, 581	742, 846	66, 772, 557	4, 206, 671	71, 729, 000	4, 590, 656	16, 965, 162
1928	8, 594, 646	1, 237, 629	53, 501, 723	3, 103, 100	71, 462, 000	4, 359, 182	16, 375, 355
1929	8, 905, 074	1, 567, 293	48, 889, 906	3, 080, 064	58, 861, 000	3, 884, 826	15, 293, 343

Gold and silver produced at placer mines in Colorado, 1920–1929, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Dredging		Total	
	Gold	Silver	Gold	Silver	Gold	Silver
1920	82.81	22	24, 810. 39	6, 694	24, 893. 20	6, 716
1921	323. 63	96	16, 348. 32	4, 346	16, 671. 95	4, 442
1922	487. 43	128	16, 753. 57	4, 100	17, 241. 00	4, 228
1923	269. 22	66	17, 360. 03	4, 056	17, 629. 25	4, 122
1924	310. 85	81	19, 934. 38	4, 873	20, 245. 23	4, 954
1925	445. 77	101	6, 825. 86	1, 798	7, 271. 63	1, 899
1926	391. 54	67	1, 879. 86	502	2, 271. 40	569
1927	364. 38	73	4, 203. 87	1, 063	4, 568. 25	1, 136
1928	502. 45	100	2, 468. 06	628	2, 970. 51	728
1929	355. 72	60	1, 862. 27	488	2, 217. 99	548

GOLD

The production of gold in Colorado in 1929, in terms of recovered metal, was 213,689.69 fine ounces, valued at $4,417,358, a decrease from 1928 of 42,933.69 fine ounces and of $887,518.

The Cripple Creek district contributed $2,640,034, or nearly 60 per cent of this total yield. The part of the San Juan region that includes Dolores, La Plata, Ouray, Rio Grande, San Juan, and San Miguel Counties yielded $1,038,217, or 23½ per cent of the State total. The largest increases were $104,489 in San Juan County, $101,745 in Ouray, $68,927 in La Plata, $60,577 in Clear Creek,

$55,362 in Eagle, and $47,039 in Gilpin. The largest decreases were $452,886 in San Miguel County, $419,147 in Teller, $211,797 in Rio Grande, $106,735 in Lake, $63,825 in Boulder, $47,902 in Park, and $15,018 in Summit.

The yield of placer gold in 1929 was $45,850, a decrease of $15,556. Summit County, with one dredge and four sluice mines, produced 89 per cent of the placer gold. The other counties producing placer gold in 1929 were Adams, Chaffee, Denver, Eagle, Gilpin, and Moffat.

SILVER

The production of silver in Colorado in 1929, in terms of recovered metal, was 4,397,377 fine ounces, valued at $2,343,802, an increase of 345,124 fine ounces in quantity but a decrease of $26,766 in value from 1928, after an increase of 276,648 fine ounces in quantity and of $224,697 in value over 1927. Dolores, La Plata, Mineral, Ouray, Rio Grande, San Juan, and San Miguel Counties, of the San Juan region, and Saguache County, geologically an outlier of the San Juan Tertiary flows, in 1929 produced 2,716,846 ounces, valued at $1,448,079, or 62 per cent of the State total. In 1928 these same counties produced 3,031,759 ounces, valued at $1,773,579, or 75 per cent of the State total. In 1929 Eagle County produced 21 per cent and San Juan County 20 per cent of the State total. Saguache County, which produced 22 per cent of the State total in 1927 and 1928, produced 16 per cent in 1929. This county was the largest producer in 1928 and second only to San Miguel County in 1927. The largest increases were 654,511 ounces in Eagle County, 402,338 ounces in Mineral, 58,914 ounces in La Plata, 44,226 ounces in San Juan, 37,925 ounces in Clear Creek, 15,470 ounces in Lake, and 11,512 ounces in Gilpin. The largest decreases were 537,629 ounces in San Miguel County, 181,440 ounces in Saguache, 80,056 ounces in Dolores, 42,512 ounces in Boulder, and 27,324 ounces in Ouray.

COPPER

The production of recoverable copper in Colorado in 1929 was 8,905,074 pounds, valued at $1,567,293, an increase of $329,664 over 1928, following an increase of $494,783 over 1927. Eagle County produced 35 per cent of the copper output, Saguache 30 per cent, San Juan 24 per cent, Dolores 4 per cent, and Lake nearly 4 per cent. The combined output of the 11 other counties producing copper was 3 per cent of the State total in 1929. Eagle County increased its production from 1,219,202 pounds, valued at $175,565, in 1928 to 3,139,000 pounds, valued at $552,464, in 1929. Other large increases were 401,347 pounds in quantity and $126,818 in value in San Juan County, 98,471 pounds in quantity and $24,327 in value in Lake County, 77,906 pounds in quantity and $14,688 in value in Gilpin County, and 36,423 pounds in quantity and $6,572 in value in Clear Creek County. The largest decreases were 1,633,000 pounds in quantity and $149,808 in value in Saguache County, 559,764 pounds in quantity and $70,134 in value in Dolores County, and 75,629 pounds in quantity and $9,762 in value in San Miguel County.

LEAD

The production of recoverable lead in Colorado in 1929, reckoned as lead in lead bullion and in leaded zinc oxide, was 48,889,906 pounds, valued at $3,080,064, a decrease of $23,036 from 1928. There were decreases in all the important lead-producing counties in 1929, with the exception of San Juan, Saguache, Mineral, and Clear Creek, in which increases were recorded in both quantity and value. Lead ores yielded 6,580,987 pounds and lead-zinc ores 33,041,776 pounds. Smelting ores of all kinds yielded 7,222,991 pounds, and concentrates of all kinds smelted yielded 41,666,915 pounds.

ZINC

The zinc-bearing ores marketed from Colorado in 1929 contained 58,861,000 pounds of recoverable zinc, valued at $3,884,826, a decrease of 12,601,000 pounds in quantity and $474,356 in value from 1928. Lake County again led in zinc production in 1929 with 26,828,000 pounds, or 46 per cent of the zinc output of the State, compared with 29,603,000 pounds, or 41 per cent, in 1928. San Juan County ranked second in 1929 with 22,858,000 pounds, or 39 per cent of the total, compared with 25,427,000 pounds, or 36 per cent, in 1928. Of the other larger zinc-producing counties Dolores showed a decrease of 3,387,000 pounds of zinc, Lake showed a decrease of 2,775,000 pounds, San Juan showed a decrease of 2,569,000 pounds, Eagle showed a decrease of 1,960,000 pounds, and Summit showed a decrease of 1,600,000 pounds from the 1928 production.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1929, by counties, in terms of recovered metals

County	Mines producing			Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Total	Fine ounces	Value	Fine ounces	Value
Adams	--------	2	2	197.03	$4,073	28	$15
Boulder	32	--------	32	1,621.92	33,528	7,852	4,185
Chaffee	4	1	5	17.85	369	1,366	728
Clear Creek	41	--------	41	4,499.50	93,013	168,850	89,997
Costilla	1	--------	1	4.89	101	11	6
Custer	6	--------	6	--------	--------	1,835	978
Denver	--------	1	1	5.56	115	--------	--------
Dolores	9	--------	9	622.39	12,866	272,985	145,501
Eagle	1	1	2	3,482.76	71,995	917,171	488,852
Gilpin	18	2	20	5,286.85	109,289	28,912	15,410
Gunnison	11	--------	11	396.48	8,196	12,405	6,612
Hinsdale	4	--------	4	34.59	715	3,165	1,687
Lake	33	--------	33	6,677.25	138,031	394,270	210,146
La Plata	7	--------	7	5,628.92	116,360	83,107	44,296
Mineral	7	--------	7	121.76	2,517	612,497	326,461
Moffat	1	1	2	5.61	116	75	40
Montezuma	1	--------	1	7.30	151	--------	--------
Ouray	13	--------	13	17,830.92	368,598	20,683	11,024
Park	8	--------	8	10,003.81	206,797	8,953	4,772
Pitkin	7	--------	7	3.00	62	98,880	52,703
Rio Grande	2	--------	2	1,634.21	33,782	6,058	3,229
Saguache	7	--------	7	1,017.96	21,043	722,319	384,996
San Juan	13	--------	13	20,869.17	431,404	871,544	464,533
San Miguel	10	--------	10	3,638.14	75,207	127,653	68,039
Summit	13	5	18	2,370.18	48,996	27,514	14,665
Teller	41	--------	41	127,711.64	2,640,034	9,244	4,927
	290	13	303	213,689.69	4,417,358	4,397,377	2,343,802
Total, 1928	336	23	359	256,623.38	5,304,876	4,052,253	2,370,568

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1929, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Adams							$4, 088
Boulder			35, 921	$2, 263			39, 976
Chaffee	6, 597	$1, 161	54, 778	3, 451			5, 709
Clear Creek	41, 472	7, 299	526, 397	33, 163	56, 000	$3, 696	227, 168
Costilla							107
Custer			22, 826	1, 438			2, 416
Denver							115
Dolores	327, 250	57, 596	7, 060, 047	444, 783	5, 905, 000	389, 730	1, 050, 476
Eagle	3, 139, 000	552, 464	395, 000	24, 885	840, 000	55, 440	1, 193, 636
Gilpin	108, 420	19, 082	120, 904	7, 617			151, 398
Gunnison	12, 761	2, 246	164, 921	10, 390	200, 000	13, 200	40, 644
Hinsdale	2, 722	479	92, 906	5, 853	42, 000	2, 772	11, 506
Lake	317, 096	55, 809	10, 343, 286	651, 627	26, 828, 000	1, 770, 648	2. 826, 261
La Plata			71, 000	4, 473			165, 129
Mineral			271, 000	17, 073			346, 051
Moffat	17, 000	2, 992					3, 148
Montezuma							151
Ouray	53, 171	9, 358	102, 824	6, 478			395, 458
Park	1, 693	298	148, 206	9, 337			221, 204
Pitkin			1, 420, 826	89, 512	202, 000	13, 332	155, 609
Rio Grande	5, 392	949	55, 237	3, 480			41, 440
Saguache	2, 667, 000	469, 392	5, 806, 000	365, 778			1, 241, 209
San Juan	2, 157, 000	379, 632	19, 012, 224	1, 197, 770	22, 858, 000	1, 508, 628	3, 981, 967
San Miguel	35, 267	6, 207	2, 448, 317	154, 244			303, 697
Summit	13, 233	2, 329	737, 286	46, 449	1, 930, 000	127, 380	239, 819
Teller							2, 644, 961
	8, 905, 074	1, 567, 293	48, 889, 906	3, 080, 064	58, 861, 000	3, 884, 826	15, 293, 343
Total, 1928	8, 594, 646	1, 237, 629	53, 501, 723	3, 103, 100	71, 462, 000	4, 359, 182	16, 375, 355

Gold and silver produced at lode and placer mines in Colorado in 1929, by counties, in terms of recovered metals

County	Lode mines					Placer mines				Grand total value
	Ore sold or treated	Gold	Silver		Total value	Gold	Silver		Total value	
	Short tons		*Fine ounces*				*Fine ounces*			
Adams						$4, 073	28	$15	$4, 088	$4, 088
Boulder	6, 176	$33, 528	7, 852	$4, 185	$37, 713					37, 713
Chaffee	191	103	1, 364	727	830	266	2	1	267	1, 097
Clear Creek	55, 975	93, 013	168, 850	89, 997	183, 010					183, 010
Costilla	17	101	11	6	107					107
Custer	68		1, 835	978	978					978
Denver						115			115	115
Dolores	33, 100	12, 866	272, 985	145, 501	158, 367					158, 367
Eagle	54, 627	71, 703	917, 169	488, 851	560, 554	292	2	1	293	560, 847
Gilpin	57, 541	109, 020	28, 910	15, 409	124, 429	269	2	1	270	124, 699
Gunnison	2, 094	8, 196	12, 405	6, 612	14, 808					14, 808
Hinsdale	3, 080	715	3, 165	1, 687	2, 402					2, 402
Lake	125, 014	138, 031	394, 270	210, 146	348, 177					348, 177
La Plata	19, 950	116, 360	83, 107	44, 296	160, 656					160, 656
Mineral	5, 436	2, 517	612, 497	326, 461	328, 978					328, 978
Moffat	51		75	40	40	116			116	156
Montezuma	20	151			151					151
Ouray	7, 514	368, 598	20, 683	11, 024	379, 622					379, 622
Park	3, 791	206, 797	8, 953	4, 772	211, 569					211, 569
Pitkin	11, 399	62	98, 880	52, 703	52, 765					52, 765
Rio Grande	4, 440	33, 782	6, 058	3, 229	37, 011					37, 011
Saguache	118, 694	21, 043	722, 319	384, 996	406, 039					406, 039
San Juan	346, 866	431, 404	871, 544	464, 533	895, 937					895, 937
San Miguel	17, 951	75, 207	127, 653	68, 039	143, 246					143, 246
Summit	9, 608	8, 277	27, 000	14, 391	22, 668	40, 719	514	274	40, 993	63, 661
Teller	288, 590	2, 640. 034	9, 244	4, 927	2, 644, 961					2, 644, 961
	1, 172, 193	4, 371, 508	4, 396, 829	2, 343, 510	6, 715, 018	45, 850	548	292	46, 142	6, 761, 160
Total, 1928	1, 426, 084	5, 243, 470	4, 051, 525	2, 370, 142	7, 613, 612	61, 406	728	426	61, 832	7, 675, 444

Gold and silver produced at placer mines in Colorado in 1929, by counties, in fine ounces

County	Sluicing and hydraulic		Dredging		Total	
	Gold	Silver	Gold	Silver	Gold	Silver
Adams	197.03	28			197.03	28
Chaffee	12.87	2			12.87	2
Denver	5.56				5.56	
Eagle	14.13	2			14.13	2
Gilpin	13.01	2			13.01	2
Moffat	5.61				5.61	
Summit	107.51	26	1,862.27	488	1,969.78	514
	355.72	60	1,862.27	488	2,217.99	548
Total, 1928	502.45	100	2,468.06	628	2,970.51	728

MINING INDUSTRY

Operating details are given under the caption, Review by Counties and Districts, but some of the more significant are noted briefly here. The Cripple Creek district produced $2,640,034 in gold in 1929, compared with $3,059,181 in 1928. At Colorado Springs the Golden Cycle mill was operated continuously, mainly on Cripple Creek mine and dump ore. At Canon City the Empire Zinc Co.'s zinc oxide plant was operated steadily on zinc concentrates from the company's flotation mill at Hanover, N. Mex. At Bonanza the Rawley mine continued in operation at a rate of 325 tons of ore a day. In the Summitville district the Little Annie mine produced only $20,413 in gold. At Creede the production of silver ore from fissures in the hanging wall of the Amethyst fault fissure totaled 5,436 tons. From White Pine zinc-lead-silver milling ore was shipped. At Eureka the Sunnyside selective flotation mill operated steadily at a rate of 1,000 tons of ore a day. Near Silverton the Mayflower mine continued to ship ore to the pilot mill installed by the Shenandoah-Dives Syndicate in the Iowa-Tiger mill in Arrastra Gulch; the Shenandoah-Dives completed a new 300-ton selective flotation mill on the west side of the Animas River opposite Arrastra Gulch. The La Plata Mines Co., at La Plata, shipped gold concentrates to Durango. The Durango lead bullion-copper matte smelter was closed three times during the year, owing to snow slides in the winter and floods in the summer between Durango and Silverton.

From Rico shipments of zinc-lead-copper-iron-silver-gold sulphide ore to Utah custom mills totaled 28,407 tons. At Ophir the Carbonero selective flotation mill was the only mill operated steadily. At Telluride the Smuggler Union mill and mine, closed in December, 1928, were sold for their salvage value. In Ouray County lessees continued the mining and milling of gold ore on the upper levels of the Camp Bird mine. At Aspen the output of silver and lead decreased; new development work was done in the Cowenhoven adit, the Midnight adit was connected by raise to the bottom of the Midnight shaft, and a 50 to 75 ton flotation mill was begun at the portal. At Gilman silver-iron pyrite and silver-iron chalcopyrite ore was shipped steadily throughout the year. A 600-ton flotation mill was built in Eagle Canyon at the mouth of the Newhouse adit; the mill was placed partly underground in an excavation cut into the granite walls of

Eagle Canyon. At Rifle the 140-ton vanadium plant was operated steadily. At Leadville the production of five metals totaled $2,826,261, compared with $2,903,122 in 1928. Only one furnace was in blast at the A. V. lead bullion-copper matte smelter. The selective flotation mill at Leadville was operated 313 days at a rate of 277 tons daily. At Climax an addition to the mill completed in November raised the tonnage treated by the old (893 tons daily) and the new (662 tons daily) mills to 40,000 tons for December. The new adit, 465 feet lower than the White adit, was driven 872 feet in 1929. It will be 4,000 feet long and cut under ore determined by diamond drilling. At Breckenridge the Wellington mill was closed on March 10 and later was sold, the Royal Tiger pilot mill was operated part time, and the Continental Dredging Co. bought and remodeled the Blue River Placer Mining Co.'s dredge and operated it from October 1 to December 31. In Park County shipments of gold ore from the London mine contained more than $200,000 in gold. In Boulder County the Nancy 50-ton flotation mill and the Wood Mountain amalgamation-concentration mill in the Sugar Loaf district, the Emancipation 25-ton flotation mill at Gold Hill, and the Buckhorn concentration mill at Jamestown were operated part of the year. In the Silver Plume-Georgetown district the East Butte flotation mill continued to treat silver dump ores. At Empire the Gold Dirt flotation mill produced gold concentrates. At Idaho Springs the Argo remodeled flotation mill at the mouth of the Argo adit was operated steadily (until it closed November 25), although not at capacity, on ore from the Kansas-Ophir-Phoenix group (unwatered in 1928) in the Nevadaville district, Gilpin County, and on custom ore from the Central adit at Idaho Springs. At Central City the Chain O'Mines (Inc.) mined and milled gold ore from "The Patch." Recovery of placer gold from gravel and sand washing plants continued in Adams County.

ORE CLASSIFICATION

Ore sold or treated in Colorado in 1929, with content in terms of recovered metals

Source	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold ore	387,072	175,823.50	106,652	182,400	437,628	----------
Dry gold-silver ore	64,682	15,515.98	270,216	570,442	1,197,829	----------
Dry silver ore	188,688	1,779.73	1,721,358	2,967,739	7,433,535	----------
	640,442	193,119.21	2,098,226	3,720,581	9,068,992	----------
Copper ore	36,539	2,974.72	784,933	3,045,195	183,845	----------
Copper-lead ore	81	13.91	3,888	7,285	14,306	----------
Lead ore	36,880	2,287.61	333,369	64,972	6,580,987	----------
Lead-zinc ore	458,251	13,076.25	1,176,413	2,067,041	33,041,776	58,861,000
	531,751	18,352.49	2,298,603	5,184,493	39,820,914	58,861,000
Total, lode mines	1,172,193	211,471.70	4,396,829	8,905,074	48,889,906	58,861,000
Total, placers	----------	2,217.99	548	----------	----------	----------
	1,172,193	213,689.69	4,397,377	8,905,074	48,889,906	58,861,000
Total, 1928	1,426,084	256,623.38	4,052,253	8,594,646	53,501,723	71,462,000

METAL CONTENT OF ZINC—BEARING MATERIALS

The following table gives the kind and grade of zinc-bearing materials marketed in 1929.

Zinc and zinc-lead ore and zinc concentrates as marketed from Colorado mines and mills in 1929, in terms of original content

Classification	County	Dry weight	Gold		Silver	
			Content	Average assay	Content	Average assay
		Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*
Sulphide:						
Crude milling ore and middlings	Dolores, Gunnison, Hinsdale, and San Juan	32,516	1,591.01	0.049	254,867	7.84
Crude milling and smelting ore	Lake, Pitkin, and Summit	9,121	219.80	.024	36,575	4.01
Total crude milling and smelting ore and middlings		41,637	1,810.81	.043	291,442	7.00
Zinc concentrates	Eagle, Lake, San Juan, and Summit	56,150	2,200.45	.039	260,791	4.64
Do	Clear Creek	77	1.70	.022	3,430	44.55
Total zinc concentrates		56,227	2,202.15	.039	264,221	4.70
Grand total		97,864	4,012.96		555,663	

Classification	Copper		Lead		Zinc	
	Content	Wet assay	Content	Wet assay	Content	Assay
	Pounds	*Per cent*	*Pounds*	*Per cent*	*Pounds*	*Per cent*
Sulphide:						
Crude milling ore and middlings	449,161	0.69	8,174,272	12.57	10,109,385	15.55
Crude milling and smelting ore	2,039	.01	1,987,178	10.89	4,683,524	25.67
Total crude milling and smelting ore and middlings	451,200	.54	10,161,450	12.20	14,792,909	17.76
Zinc concentrates	757,525	.67	4,549,813	4.05	57,713,105	51.39
Do	285	.19	3,779	2.45	67,720	43.97
Total zinc concentrates	757,810	.67	4,553,592	4.05	57,780,825	51.38
Grand total	1,209,010		14,715,042		72,573,734	

METALLURGIC INDUSTRY

Custom reduction plants.—The following custom reduction plants operated in the State during 1929: The lead bullion-leady copper matte smelters at Durango and Leadville; the zinc oxide plant at Canon City; the Golden Cycle roast-amalgamation-cyanidation mill at Colorado Springs; the Argo selective flotation mill at Idaho Springs; the sampling plants at Idaho Springs and Boulder; the arsenic-cadmium plant at the old Globe smelter, Denver; and the Leadville zinc-lead flotation mill at Leadville.

Mines in Colorado in 1929 produced 1,172,193 tons of ore, of which 101,473 tons, or 8.66 per cent, was shipped crude to smelters; 378,056 tons, or 32.25 per cent, went to amalgamation and cyanidation mills with or without supplementary concentration; and 692,664 tons, or 59.09 per cent, went to mills equipped for concentration only. Of the 378,056 tons of ore to amalgamation and cyanidation mills 66,768 tons was given additional treatment by concentration methods. This tonnage, added to the 692,664 tons already mentioned, makes 759,432 tons of ore treated by concentration methods and is equivalent to 64.79 per cent of the State total.

Amalgamation and cyanidation.—The 378,056 tons of ore treated at amalgamation and cyanidation mills was classified as follows: Dry gold ore, 375,855 tons, or 99.42 per cent; dry gold and silver ore, 1,752 tons, or 0.46 per cent; and dry silver ore, 449 tons, or 0.12 per cent. Of the total material treated by amalgamation and cyanidation 313,612 tons was ore amalgamated, 50,873 tons was ore and concentrates cyanided direct, and 288,590 tons was sands and slimes (from certain ores first treated by amalgamation) given an additional treatment by cyanidation.

Concentrating plants.—The 692,664 tons of ore treated by concentration only was classified as follows: Dry gold ore, 6,190 tons, or 0.89 per cent; dry gold and silver ore, 62,804 tons, or 9.07 per cent; dry silver ore, 155,827 tons, or 22.50 per cent; lead ore, 15,869 tons, or 2.29 per cent; lead-zinc ore, 451,974 tons, or 65.25 per cent.

Thirty concentrating plants (including six using preliminary amalgamation) in Colorado were active in 1929. Ten of these employed tables in addition to other equipment; 1 employed jigs and tables; 1 employed jigs, tables, and flotation; and 18 were all-flotation mills.

Flotation concentration.—Practically all of the concentrates indicated herein for Colorado were recovered by flotation and hence need not be divided by methods of recovery.

Concentrates were made at three mills by other methods, as follows: One mill in Clear Creek County recovered 97 tons of lead-zinc concentrates by jig and table; 1 in Eagle County recovered 132 tons of lead concentrates by jig; and 1 in Ouray recovered 615 tons of gold concentrates by gravity concentration. All other concentrates were made by the flotation method.

Gross metal content of concentrates produced from ores mined in Colorado in 1929, by classes of concentrates

Class of concentrates	Concentrates produced (dry weight)	Gross metal content				
		Gold	Silver	Copper (wet assay)	Lead (wet assay)	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	1,827	5,142.25	10,469	47,436	110,746	210,668
Dry gold and silver	857	5,839.35	89,205	314	84,340	5,376
Copper	1,099	2,426.20	24,826	127,812	83,496	114,547
Copper-lead	39,896	18,716.88	1,396,083	5,592,831	23,933,294	7,190,349
Lead	18,907	2,215.37	608,563	277,864	18,066,354	2,675,206
Lead-zinc	29,407	3,099.12	193,727	577,214	3,705,962	27,627,431
Zinc	41,227	428.54	139,494	383,763	1,562,057	39,967,032
	133,220	37,867.71	2,462,367	7,007,234	47,546,249	77,790,609
Total, 1928	158,736	49,848.23	3,192,519	9,648,481	53,101,096	87,111,050

Mine production of metals in Colorado in 1929, by methods of recovery

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated	313,612	48,714.25	7,378			
Ore, concentrates, sands, and slimes cyanided	339,463	104,148.63	45,581			
Concentrates smelted	133,220	37,754.07	2,418,481	5,471,238	41,666,915	56,370,000
Ore smelted	101,473	20,854.75	1,925,389	3,433,836	7,222,991	2,491,000
Placer		2,217.99	548			
		213,689.69	4,397,377	8,905,074	48,889,906	58,861,000
Total, 1928		256,623.38	4,052,253	8,594,646	53,501,723	71,462,000

Ore treated by amalgamation, ore, concentrates, sands, and slimes treated by cyanidation, and gold and silver contained in bullion and precipitates in Colorado in 1929

Process	Material treated	Gold in bullion	Silver in bullion	Quicksilver purchased	Sodium cyanide used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amalgamation	313,612	48,714.25	7,378	1,373	--------
Cyanidation	[1] 339,463	104,148.63	45,581	--------	[2] 297,025
	--------	152,862.88	52,959	1,373	[2] 297,025

[1] Includes 50,873 tons of raw ore and concentrates treated by direct cyanidation and 288,590 tons of sands and slimes from ore first amalgamated.

[2] Reduced to equivalent of 96 to 98 per cent strength. Actually 594,050 pounds of cyanamid of approximately 48 to 49 per cent strength.

Mine production of metals from gold and silver mills in Colorado in 1929, by counties, in terms of recovered metals

County	Ore treated	Recovered in bullion		Concentrates and recovered metal					
		Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	5,099	1,434.89	3,203	--------	--------	--------	--------	--------	--------
Clear Creek	12,310	3,089.80	5,408	52	141.45	2,652	251	4,435	--------
Gilpin	57,383	1,832.17	580	2,015	3,303.21	25,911	107,669	67,987	--------
Gunnison	948	252.26	216	31	61.70	1,084	--------	17,254	--------
Lake	3,377	2,936.02	6,849	--------	--------	--------	--------	--------	--------
Mineral	542	79.76	18,416	--------	--------	--------	--------	--------	--------
Montezuma	20	7.30	--------	--------	--------	--------	--------	--------	--------
Ouray	6,467	9,763.41	3,838	615	3,888.12	6,539	19,000	55,378	--------
Park	1,575	2,482.63	1,201	24	91.00	159	379	3,692	--------
Rio Grande	108	958.31	207	--------	--------	--------	--------	--------	--------
Saguache	8	11.95	--------	--------	--------	--------	--------	--------	--------
San Miguel	--------	2,210.64	1,728	--------	--------	--------	--------	--------	--------
Summit	1,629	92.10	2,069	161	163.80	8,690	13,233	81,007	--------
Teller	288,590	127,711.64	9,244	--------	--------	--------	--------	--------	--------
	378,056	152,862.88	52,959	2,898	7,649.28	45,035	140,532	229,753	--------
Total, 1928	630,718	184,373.13	211,670	17,116	20,530.00	500,743	47,229	3,244,548	12,000

Mine production of metals from concentrating mills in Colorado in 1929, by counties in terms of recovered metals

County	Ore treated	Concentrates and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	1,060	212	176.24	1,346	--------	33,858	--------
Clear Creek	43,231	1,679	1,119.38	150,529	39,555	357,149	56,000
Dolores	28,907	15,227	469.04	197,533	240,598	5,578,335	5,905,000
Eagle and Summit	18,932	3,806	108.23	12,137	--------	704,829	2,749,000
Gunnison	550	55	56.40	5,133	142	18,429	--------
Hinsdale	3,000	85	32.50	406	1,362	64,686	20,000
Lake	89,681	36,817	354.23	232,744	200,000	7,434,000	24,622,000
LaPlata	19,824	723	5,177.60	75,757	--------	71,000	--------
Pitkin	602	251	--------	4,230	--------	82,000	160,000
Rio Grande	4,300	85	597.80	5,850	5,392	55,237	--------
Saguache	118,647	18,967	1,003.50	720,172	2,663,600	5,798,200	--------
San Juan	346,736	50,360	20,843.07	864,906	2,152,064	18,971,935	22,858,000
San Miguel	17,194	2,055	166.80	102,703	27,993	2,267,504	--------
Summit	(1)	(1)	(1)	(1)	(1)	(1)	(1)
	692,664	130,322	30,104.79	2,373,446	5,330,706	41,437,162	56,370,000
Total, 1928	712,490	141,620	28,532.03	2,559,858	6,988,529	41,043,553	61,807,000

[1] Included with Eagle County.

Mine production of metals from Colorado concentrates in 1929, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	212	176.24	1,346		33,858	
Clear Creek	1,731	1,260.83	153,181	39,806	361,584	56,000
Dolores	15,227	469.04	197,533	240,598	5,578,335	5,905,000
Eagle and Summit	3,967	272.03	20,827	13,233	785,836	2,749,000
Gilpin	2,015	3,303.21	25,911	107,669	67,987	
Gunnison	86	118.10	6,217	142	35,683	
Hinsdale	85	32.50	406	1,362	64,686	20,000
Lake	36,817	354.23	232,744	200,000	7,434,000	24,622,000
La Plata	723	5,177.60	75,757		71,000	
Ouray	615	3,888.12	6,539	19,000	55,378	
Park	24	91.00	159	379	3,692	
Pitkin	251		4,230		82,000	160,000
Rio Grande	85	597.80	5,850	5,392	55,237	
Saguache	18,967	1,003.50	720,172	2,663,600	5,798,200	
San Juan	50,360	20,843.07	864,906	2,152,064	18,971,935	22,858,000
San Miguel	2,055	166.80	102,703	27,993	2,267,504	
Summit	(1)	(1)	(1)	(1)	(1)	(1)
	133,220	37,754.07	2,418,481	5,471,238	41,666,915	56,370,000
Total, 1928	158,736	49,062.03	3,060,601	7,035,758	44,288,101	61,819,000

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	1,827	5,142.25	10,469	34,467	57,269	
Dry gold and silver	857	5,839.35	89,205	251	75,885	
Copper	1,099	2,426.20	24,826	102,249	75,145	
Copper-lead	39,896	18,716.88	1,396,083	4,439,191	21,539,234	
Lead	18,907	2,215.25	608,493	223,734	16,230,504	
Total to copper and lead plants	62,586	34,339.93	2,129,076	4,799,892	37,978,037	
Lead-zinc	29,407	3,099.12	193,727	408,000	3,107,000	22,858,000
Zinc	41,227	315.02	95,678	263,346	581,878	33,512,000
Total to zinc and lead plants	70,634	[2] 3,414.14	[2] 289,405	[2] 671,346	[3] 3,688,878	[4] 56,370,000
	133,220	37,754.07	2,418,481	5,471,238	41,666,915	56,370,000

[1] Included with Eagle County.
[2] Recovered in zinc residues.
[3] Lead recovered in zinc residues and leaded zinc oxide.
[4] Zinc recovered as metal and zinc in zinc oxide.

Gross metal content of Colorado crude ore shipped to smelters in 1929, by classes of ore

Class of ore	Ore		Gross metal content				
			Gold	Silver	Copper	Lead	Zinc
	Short tons	*Per cent*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	5,027	4.95	14,537.30	32,311	55,380	224,523	239,544
Dry gold and silver	145	.14	449.44	8,767	463	6,904	4,001
Dry silver	32,393	31.92	677.30	848,318	403,816	1,625,084	1,627,457
Copper	36,539	36.01	2,974.72	784,933	3,189,804	357,861	14,183
Copper-lead	81	.08	13.91	3,888	8,917	16,860	4,756
Lead	21,011	20.71	2,189.38	239,365	52,062	4,778,812	1,432,382
Lead-zinc	6,277	6.19	176.66	29,689	13,540	1,468,669	3,140,411
	101,473	100.00	21,018.71	1,947,271	3,723,982	8,478,713	6,462,734
Total, 1928	82,876		20,339.35	860,415	1,727,769	11,558,838	13,314,581

Mine production of metals from Colorado crude ore shipped to smelters in 1929, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	17	10.79	3,303	------------	2,063	------------
Chaffee	191	4.98	1,364	6,597	54,778	------------
Clear Creek	434	148.87	10,261	1,666	164,813	------------
Costilla	17	4.89	11	------------	------------	------------
Custer	68	------------	1,835	------------	22,826	------------
Dolores	4,193	153.35	75,452	86,652	1,481,712	------------
Eagle	43,353	3,451.60	914,921	3,139,000	217,000	------------
Gilpin	158	138.46	2,419	751	52,917	------------
Gunnison	596	26.12	5,972	12,619	129,238	200,000
Hinsdale	80	2.09	2,759	1,360	28,220	22,000
Lake	31,956	3,387.00	154,677	117,096	2,909,286	2,206,000
La Plata	126	451.32	7,350	------------	------------	------------
Mineral	4,894	42.00	594,081	------------	271,000	------------
Moffat	51	------------	75	17,000	------------	------------
Ouray	1,047	4,179.39	10,306	34,171	47,446	------------
Park	2,216	7,430.18	7,593	1,314	144,514	------------
Pitkin	10,797	3.00	94,650	------------	1,338,826	42,000
Rio Grande	32	78.10	1	------------	------------	------------
Saguache	39	2.51	2,147	3,400	7,800	------------
San Juan	130	26.10	6,638	4,936	40,289	------------
San Miguel	757	1,260.70	23,222	7,274	180,813	------------
Summit	321	53.30	6,352	------------	129,450	21,000
	101,473	20,854.75	1,925,389	3,433,836	7,222,991	2,491,000
Total, 1928	82,876	20,217.71	779,254	1,558,888	9,213,622	9,643,000

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry gold	5,027	14,537.30	32,311	44,242	201,994	------------
Dry gold and silver	145	449.44	8,767	347	6,214	------------
Dry silver	32,393	677.30	848,318	286,666	1,462,775	------------
Copper	36,539	2,974.72	784,933	3,045,195	183,845	------------
Copper-lead	81	13.91	3,888	7,285	14,306	------------
Lead	21,011	2,189.38	239,365	41,219	4,304,544	------------
Total to copper and lead plants	95,196	20,842.05	1,917,582	3,424,954	6,173,678	------------
Lead-zinc	6,277	12.70	7,807	8,882	1,049,313	2,491,000
Total to zinc smelters and zinc oxide plants	6,277	[1] 12.70	[1] 7,807	[1] 8,882	[2] 1,049,313	[3] 2,491,000
	101,473	20,854.75	1,925,389	3,433,836	7,222,991	2,491,000

[1] Recovered in zinc residues.
[2] Lead recovered in zinc residues and leaded zinc oxide.
[3] Zinc recovered as metal and zinc in leaded zinc oxide.

REVIEW BY COUNTIES AND DISTRICTS

ADAMS COUNTY

Sluice boxes placed below the waste flumes of the Brannan and Gordon sand and gravel plants, on Clear Creek, recovered $4,073 in gold and 28 ounces of silver in 1929. The average yearly fineness of the Brannan yield after melting at the Denver Mint was 0.869 gold and 0.127 silver and of the Gordon yield 0.792 gold and 0.119 silver. From 1922, when the sluices were first placed below these gravel and sand plants, to 1929, inclusive, $19,345 in gold and 141 ounces of silver have been recovered. Production of the county before 1922 is covered in the 1928 report of this series.

ALAMOSA COUNTY

Development work was continued in 1929 at the Red Eagle prospect in the West Blanca district; the property is reported as 7 miles from the nearest railroad point but is 12 miles from Blanca. It is opened by a 127-foot adit.

ARCHULETA COUNTY

Development work was continued at the Treasure Comstock prospect in T. 36 N., R. 3 E., New Mexico principal meridian, and west of Summitville. The property is opened by a 375-foot adit and 40 feet of drifts. The mineralization is lead-zinc-silver-gold-copper sulphide, replacing limestone beds.

BACA COUNTY

Development work was continued at the Independence prospect near Utleyville. Production from this region in the past has been from rounded nodules of chalcocite in a white sandstone.

BOULDER COUNTY

Central district (*Jamestown*).—In 1929 three mines near Jamestown produced 1,079 tons of ore, yielding $4,124 in gold, 1,379 ounces of silver, and 33,858 pounds of lead. The principal producer was the Buckhorn, an old property reopened in 1928. Most of the ore was milled in a 50-ton flotation mill in the district. Products were dry gold-silver and lead-silver-gold concentrates. Operators of a fluorspar custom milling plant also recovered lead-silver-gold concentrates as a by-product. A 5-ton lot of gold ore was picked up from the Wano dump and shipped.

Gold Hill district.—The Gold Hill district in 1929 produced 1,134 tons of ore, which yielded in terms of recovered metals by amalgamation, cyanidation, and direct smelting $8,898 in gold, 2,270 ounces of silver, and 904 pounds of lead. The Emancipation 25-ton flotation mill, built in 1928, was operated intermittently over a period of nine months in 1929. The product was gold concentrates; these were sold to the Golden Cycle mill, at Colorado Springs, where they were treated by cyanidation. Gold concentrates from the Lucky Star mill were also shipped to the Golden Cycle mill. Other producers, mostly of dry gold ore shipped direct to the Golden Cycle mill, were the Atlantic, Big Horn, Buena Ventura, Glad Eye, Grace, Morning Glory, Poorman-Relief, and Slide.

Grand Island district (*Cardinal, Caribou, Eldora, and Nederland*).—The only production from the Grand Island district in 1929 was the shipment to the Boulder Ore Sampling Works, at Boulder, of a few tons of gold-silver ore from a clean-up from the Boulder County mill at Cardinal.

Magnolia district.—Several small lots of ore aggregating 14 tons, containing 12 ounces of gold and 5 ounces of silver, were mined from five properties in the Magnolia district and sold to the Boulder sampler.

Sugar Loaf district.—Seven mines in the Sugar Loaf district in 1929 produced 3,911 tons of ore, which yielded $18,806 in gold, 3,882 ounces of silver, and 1,159 pounds of lead. The principal producers were the Logan, Nancy group, and Wood Mountain. The 50-ton flotation mill on the Nancy group was operated for five months.

Ward district.—Five properties—the B & M, Binford, Blue Coat, New Market, and Yellow Bird-Elsie Owen—in the Ward district in 1929 produced 20 tons of dry gold ore, carrying 31.57 ounces of gold and 63 ounces of silver.

CHAFFEE COUNTY

Chalk Creek district (*Romley*).—The Mary Murphy mine and mill in the Chalk Creek district remained idle in 1929. A 1-ton lot of lead-silver ore was shipped to the Leadville smelter from the Weldon prospect.

Granite district.—In 1929 the general merchandise store at Granite exchanged merchandise for 17 ounces of placer gold mined in the vicinity. This bullion when melted at the Denver Mint averaged 0.834 fineness gold and 0.157 fineness silver.

Monarch-Garfield district.—Lead-silver-gold smelting ore shipped in 1929 to the Leadville smelter from the Iron Duke, Madonna, and Wilson properties in the Monarch-Garfield district totaled 190 tons.

CLEAR CREEK COUNTY

Alice district (*Yankee, Lincoln*).—A small bar of gold bullion was marketed in 1929 from the Caddo mill, representing the results of treatment of ore from the Yukon mine in 1928. This amalgamation-gravity concentration-flotation mill, rated at 100 tons capacity daily, was built in 1928 and operated a few days that year but was idle in 1929. The report for 1929 indicates that the Yukon mine is opened by a 1,300-foot adit; development including the adit totals 3,000 feet. The equipment of the Caddo mill consists of 1 Blake crusher, 20 McFarlane stamps (1,250 pounds each), 8 amalgamating plates, 4 twenty-mesh screens, 1 McFarlane-Eggers ball mill, 2 Wilfley and 2 Deister-Plato tables, 1 eight-cell Fahrenwald flotation machine, and 1 dryer. A lessee on the Lombard property did no development work in 1929 but mined and milled 417 tons of ore, yielding lead-gold-silver concentrates. The mill was operated 20 days at less than six hours each day. It is at the portal of a 1-mile adit and is equipped with 1 crusher, 20 stamps, 1 ball mill, 4 concentrating tables, and 1 flotation machine.

Argentine district (*Silver Plume*).—From July 1 to November 1 the Mount Kelso Mining Fund drove 60 feet of drifts and 65 feet of stopes and extracted 401 tons of lead-silver-gold-[zinc] ore from the National mine. Most of this ore was shipped direct to the Leadville smelter, but 45 tons was sold to the Argo custom mill at Idaho Springs and 18 tons was milled at the Commonwealth concentration mill at Georgetown. The Santiago property, developed by a drift from the Waldorf adit, became a small producer in 1929, shipping one car of lead-silver-gold ore to the Leadville smelter and several hundred tons of lead-silver-gold-[zinc] sulphide ore to the Newton mill at Idaho Springs.

Empire district.—The Gold Dirt flotation mill was operated in 1929 from January 1 to September 1. Dry gold ore milled yielded dry gold concentrates, which were sold to the Golden Cycle mill. Development at the Gold Dirt mine in 1929 consisted of 420 feet of drifts and 120 feet of raises. Other producing mines in the district were the Bi-Metallic, Cashier, Mint, Silver Mountain, and Superior. A 5-ton lot of lead-silver-gold ore was mined and shipped from the Colorado Standard prospect near Jones Pass, out from Empire. The equipment of the Gold Dirt mill consists of 1 Universal crusher, 1 Ruth rod mill, 1 Akins classifier, 2 Plato concentration tables, 2 Ruth 8-cell flotation cells, 1 Portland filter, and 1 Hendryx thickening tank.

Griffith district (*Georgetown-Silver Plume*).—In 1929 six mines in the Georgetown-Silver Plume district produced 37,526 tons of ore, yielding $272 in gold, 130,071 ounces of silver, 199 pounds of copper, 210,016 pounds of lead, and 56,000 pounds of zinc, in terms of recovered metals, with a gross calculated value for the five metals of $86,562, compared with $85,291 in 1928. From April to November, inclusive, a lessee, the Butte Mining Co., treated 35,055 tons from the Corry City dump in the 250-ton Nashotah mill at Silver Plume. In preparation for underground mining the lessee also cleaned 500 feet of drifts along the Pelican vein and drifted 100 feet and raised 50 feet on the Corry City vein in the Diamond adit. The East Butte Copper Mining Co., of Butte, Mont., in 1925 remodeled the Nashotah, an old mill at Silver Plume, and operated it during 1926. It remained idle in 1927 but in 1928 was leased by the Butte Mining Co. The equipment in 1929 consisted of one 15 by 24 inch crusher, one grizzly, one 16 by 40 inch and one 16 by 36 inch Colorado Iron Works rolls, one 8 by 3 foot Hardinge ball mill, four 16-foot by 45-inch Akins classifiers, one 6-cell 18 by 9 foot Janney flotation machine, two 5-cell Akins flotation machines, one 6½-foot Portland filter, and one 20 by 10 foot Dorr thickening tank. The Watrous 65-ton flotation mill, built in 1924 and operated intermittently from 1924 to 1926, was used in 1929 to treat as custom ore 1,600 tons of lead-zinc-silver ore from the Smuggler dump. The equipment of the Watrous mill consists of 1 Universal crusher, 1 Ruth rod mill, 2 Denver Equipment Co.'s classifiers, 3 Wilfley tables, and 1 Ruth and 2 Fahrenwald flotation machines. The Commonwealth concentration mill at Georgetown, in addition to treating some custom ore from the National mine in the Argentine district, was used to test a few tons of ore from the Mayfield vein of the Commonwealth Tunnel Transportation Co. The Wasatch-Colorado jigs-table concentration mill at Silver Plume was operated from July 1 to November 1 on ore from the Mendota-Frostberg group. This mill is equipped with 1 Universal and 1 Blake crusher, 3 Walker trommels, 2 Walker rolls, 4 Richards pulsating classifiers, 1 Wilfley and 3 Card gravity concentration tables, and 6 four-compartment Harz jigs. Products in 1929 were lead-silver-gold and zinc-lead-silver-gold concentrates. Development at the Mendota-Frostberg in 1929 comprised one vertical raise (96 feet), retimbering of one double raise (96 feet), and 145 feet of drifts and stopes. The St. George 60-ton gravity concentration-flotation mill below Georgetown was idle in 1929. The mill equipment consists of 1 Blake crusher, 1 Colorado Iron Works ball mill, 1 Akins classifier, 4 Wilfley tables, and 1 Minerals Separation 8-cell flotation machine.

Idaho Springs district.—Sixteen mines in the Idaho Springs district produced 5,685 tons of ore, yielding $52,625 in gold, 27,940 ounces of silver, 37,068 pounds of copper, and 127,984 pounds of lead, with a total gross calculated value for the four metals of $82,104, compared with $24,479 in 1928 and with $61,485 in 1927. Important producing mines were the Bald Eagle-Edgar, Lincoln, and Little Mattie. Other producing mines were the Black Eagle, Brighton, Bullion, Free Gold, Idaho Bride, Little Emma, Torpedo, Treasure Vault, and West Gold. The Quartz Hill Holding Co., lessees on the Bald Eagle-Edgar group of the North American Mining Co., sold their ore to the Argo mill, and the copper-lead-silver-gold concentrates made at the Argo mill were sold to the Clear Creek-Gilpin Ore Sampling Co., which in turn sold the concentrates to the Leadville smelter. The North American Mining Co., owner of the Big 5 or Central adit, kept the power plant and transportation facilities in order for service to lessees. Development work on the Virginia Canon level of the Bald Eagle in 1929 consisted of 119 feet of drifting and 25 feet of raises; on the Central Tunnel level on the Fulton vein, 88 feet of drifting; and on the Edgar in winzes from the Central Tunnel, 828 feet of drifting, 166 feet of crosscutting, and 247 feet of of raises. In the winze on the Edgar vein a skip and track were put down to the 200-foot sublevel. At the Miami Tunnel repairing and cleaning of workings to the bottom of the old Edgar shaft and repairing of the shaft collar were done. Development work on the Lincoln in 1929 totaled 300 feet. The ore, principally a dry gold ore, was sold to the Golden Cycle mill at Colorado Springs and to the Argo mill at Idaho Springs. The Little Mattie ore, principally dry gold ore, was in part sold to the Golden Cycle mill and in part treated in the Mattie new 100 to 150 ton amalgamation-concentration mill. This mill, begun in 1926, was completed in 1929. The equipment consists of 1 Blake and 1 Universal crusher, 3 amalgamating plates, 1 Ruth rod mill, 1 Akins classifier, 4 Deister concentrating tables, and 2 Ruth flotation machines.

The Argo mill, at the portal of the 4.16-mile Argo or Newhouse adit, was remodeled in the spring of 1928, principally to treat ores of the Gilpin County holdings of the Quartz Hill Holding Co., but it was also used as a custom mill in 1929. The mill, as remodeled, has a capacity of 150 tons in 24 hours. The flow sheet is as follows: 11 receiving bins of 770 tons capacity, 24-inch pan conveyor, 16 by 24 inch Universal crusher, 16-inch belt conveyor, Vezin sampling plant, belt and cup elevator, to 11 storage bins of 880 tons capacity with 16-inch conveyor, to belt and cup elevator, to mill supply bin of 80 tons capacity to Stephens Adamson pan feeder, to 6 by 5 foot Marcy ball mill, to 24 by 24 inch 12-mesh Weinig screen, to Dorr duplex classifier, to automatic sampler, to conditioner, to 12-cell Minerals Separation flotation machine. High-grade gold-silver-copper-lead concentrates go to American 4-leaf filter. Iron concentrates in 1929 went to the Golden Cycle mill or to the retaining pond; when tonnage is sufficiently high, there is a regrind equipment, consisting of a Wilfley pump, a 5 by 8 foot Stearns Roger ball mill, a Dorr duplex classifier, and an 8-cell Minerals Separation flotation machine. In addition, for zinc treatment (not used), there are two conditioners and one 12-cell Minerals Separation flotation machine. Another unit used only for ores high in gold or particularly free takes certain sizes from the Weinig screen to a belt and cup elevator to 2 Plateau top Card tables to 1 grinding pan to amalgamating plate. The mill was closed November 25, 1929.

Montana district (*Lawson, Dumont*).—Seven mines in the Montana district in 1929 produced 683 tons of ore, yielding $1,332 in gold, 6,683 ounces of silver, 4,205 pounds of copper, and 34,301 pounds of lead, with a total gross calculated value of $7,795, compared with $6,123 in 1928. Producing mines were the Albro, Albro Extension, Commodore Tunnel group, Jo Reynolds, Legal Tender, Princess of India, and Startle. A lessee on the Albro milled the ore extracted from the Albro and Albro Extension at the Dumont concentration mill, making copper-silver-gold concentrates. The Red Elephant flotation mill was run for a short time on silver ore from the Commodore Tunnel group.

Trail Creek district (*Lamartine, Freeland*).—The only production in the Trail Creek district in 1929 was 32 tons of lead-silver-gold-[zinc] smelting ore which was shipped from the Crazy Girl mine to the Clear Creek-Gilpin Ore Sampling Co.'s sampler at Idaho Springs.

COSTILLA COUNTY

One car of gold-silver ore was shipped to the Leadville smelter from the Bulls Eye prospect in the Grayback mining district.

CUSTER COUNTY

Oak Creek district (*Ilse*).—The Terrible mine, at Ilse, 23 miles from Florence, remained idle in 1929, except for a small force of men to keep the pumps at work. From 1922 to 1927 the mine was a producer of high-grade cerussite concentrates containing only lead without gold, silver, or other metals.

Rosita district.—The Steel Galena Mines Co., operating the Old Prairie Dog group in section 35, T. 21 S., R. 71 W., sank 40 feet of shaft and drove 40 feet of drifts in 1929; the total development comprises a 130-foot vertical shaft and 40 feet of drifts. The gasoline plant was replaced by electric equipment. Equipment consists of a hoist, compressor, and pump. A 1-ton test lot of silver-lead ore was shipped to the Leadville smelter in 1929. Harry McCormick shipped a 1-ton test lot of silver-lead ore from his prospect at Rosita, and the Rosita Mining & Milling Co. shipped a 6-ton lot of silver-lead ore from Rosita to the Leadville smelter.

Westcliffe-Silver Cliff district.—Three carloads of silver-lead ore were shipped in 1929 from the Westcliffe-Silver Cliff district to the Leadville smelter—27 tons from the Black Friday, 22 tons from the King of the Carbonates, and 11 tons from the Passiflora.

DENVER COUNTY

F. D. Goody, with the use of his placer machine, recovered 5.96 ounces of gold back of the Ford plant, within the city limits of Denver. When melted at the Denver Mint the bullion weighed 5.87 ounces and assayed 0.947½ fineness gold and 0.050½ fineness silver.

DOLORES COUNTY

The total gross calculated value of the estimated recoverable gold, silver, copper, lead, and zinc from ore mined and sold from mines in Dolores County in 1929 (nearly all from Rico) was $1,050,476, compared with $1,448,777 in 1928, $1,432,554 in 1927, $990,281 in 1926, $353,563 in 1925, and $24,220 in 1924.

Lone Cone district (*Dunton*).—The Emma Development Co. in 1929 continued catching up old workings at the Emma mine. No new development work was done. The mill on the property was operated about a month and a half on approximately 500 tons of old stope fill and some accessible ore. One car of dry gold and silver ore carrying some lead and zinc was shipped direct to Durango. The milling was experimental, using an acid circuit and only two reagents, pine oil (about 1 pint to the ton) and sodium xanthate (0.25 pound to the ton). The machinery in the mill consists of a crusher, a 25-ton ball mill, an old type of Minerals Separation flotation machine, and an Akins classifier. Concentrates made were dry gold and silver containing also a little lead and zinc. At the mine 4 men were employed underground and 4 on the surface (1 shift) for 153 days; at the mill 2 men were employed (2 shifts) for 44 days.

Pioneer district (*Rico*).—The Rico district in 1929 produced 32,574 tons of ore, yielding in terms of recovered metals $11,016 in gold, 268,783 ounces of silver, 327,250 pounds of copper, 7,059,346 pounds of lead, and 5,905,000 pounds of zinc. Most of the ore was zinc-lead-copper-silver-gold sulphide ore shipped to the custom flotation mills of the United States Smelting, Refining & Mining Co. at Midvale, Utah, and of the Combined Metals Reduction Co. at Bauer, Utah; the remainder was oxidized and sulphide lead-silver-gold and copper-silver-gold ores shipped to the Durango (Colo.) smelter. The two largest producing mines were the Rico Argentine and the St. Louis Smelting & Refining Co. Other producers were the Falcon Lead Mining Co., Rico Enterprise Mining Co., and Union Carbonate Mines (Inc.). The International mill at Rico remained idle. Its equipment consists of 1 Traylor 12 by 24 inch jaw crusher, 1 Anaconda set of rolls, 1 Hardinge 8 by 3 foot ball mill, 1 Dorr 12-foot classifier, 2 Minerals Separation 14-cell flotation machines, 1 American 6-disk filter, and 2 Dorr thickening tanks.

EAGLE COUNTY

Battle Mountain district (*Red Cliff, Gilman*).—The Empire Zinc Co. in 1929 continued underground development of its large acreage of mining property (called the "Eagle mine") at Gilman, continued to ship to Utah smelters copper-iron-silver-gold sulphide and iron-silver-gold ore (containing also a low content of copper and lead), and completed a 600-ton tables, jigs, and flotation mill in an excavation cut into the granite face of Eagle Canyon at the mouth of the Newhouse adit; excavation for the mill began about July 1, 1928.

The mill was set in operation in October, 1929, and continued through November and December on zinc-lead-silver ore, yielding zinc and lead-silver concentrates. Tailings are flumed 10,000 feet to a tailings pond at Astor Flats (or Rex) where Eagle Canyon broadens after leaving Eagle Canyon gorge. The Public Service Co. supplies electricity for the mine and mill from a new transformer station at Climax, Colo., and a new power line from Climax via Robinson and Eagle River, forming a loop with a power line from Shoshone hydroelectric plant.

McCoy district.—On the Colorado River 3 miles southwest of McCoy in section 2, T. 2 S., R. 84 W., the Bjorn Placer Mining Syndicate, using a dry-land dredging apparatus and sluice boxes, recovered gold bullion. When melted at the Denver Mint this bullion assayed 0.836 fineness gold and 0.155 fineness silver.

EL PASO COUNTY

The Golden Cycle mill at Colorado Springs, El Paso County, treats all the gold telluride ores, containing 0.1125 ounce gold and above, from the Cripple Creek district, Teller County. The mill when built in 1907 was a 1,200-ton roast-amalgamation-cyanidation mill. Since 1927 a supplementary installation of crushers, a ball mill, and a Dorr classifier has been used to treat in an all-sliming cyanidation circuit, without preliminary roasting, gold pyrite ores and concentrates from Leadville, Empire, Idaho Springs, and Russell Gulch; siliceous gold ore from the London mine west of Alma Junction, Park County; siliceous silver ores from Creede; and high-grade specimen gold ore from Summitville. In 1929 crushers, ball mills, and Fahrenwald flotation machines were installed to treat any ores offered, including zincky ores. This addition to the plant began operating in November, 1929. The Golden Cycle mill is operated by electricity developed at the mill by steam turbine. Coal for roasting the ore and for firing the boilers comes from the Pikes Peak mine just north of Colorado Springs. A sand dump of several million tons containing a small quantity of gold has been built up on the ground surrounding the mill. Experiments by the United States Bureau of Mines have shown that this tailings pile also contains potassium silicates. For description of the mill, see Teller County (p. 958).

FREMONT COUNTY

No mines in Fremont County were productive in 1929.

Canon City-Florence mills and smelters.—The Empire Zinc Co's. magnetic separation plant at Canon City was abandoned early in 1928, but its zinc oxide plant at Canon City continued operation throughout 1929 on zinc concentrates from the company's flotation mill at Hanover, N. Mex. The St. Louis Smelting & Refining Co.'s matting, fuming, and zinc oxide plant at Florence remained idle in 1929.

GARFIELD COUNTY

Newcastle district.—No work was done in 1929 on the Gray Eagle property near Newcastle.

Rifle Creek district (*Rifle*).—The 110 to 140 ton salt-roast, leach, and precipitation plant of the United States Vanadium Corporation (subsidiary of the Union Carbide & Carbon Co.) at Rifle, on the Denver & Rio Grande Western Railroad, was operated steadily in 1929. The mine is on Rifle Creek 12 miles from Rifle, and the ore is hauled to the mill by gasoline trucks. The vanadium ore is found in a sandstone formation. Beyond the vanadium mine in limestone formations, said to be older than the sandstone, is the Grand View-Lead King zinc-lead-gold-silver prospect. In 1929 roads were built on this property, a water line was laid, a steam power plant was built, a stamp and jig-tables concentrating mill was built, and 500 feet of underground development was done.

GILPIN COUNTY

In 1929 Gilpin County lode mines produced 57,541 tons of ore, yielding $109,020 in gold, 28,910 ounces of silver, 108,420 pounds of copper, and 120,904 pounds of lead, with a gross calculated value of $151,126, compared with $81,886 in 1928 and $39,696 in 1927. With the exception of 133 tons of lead ore, all the ore was classified as dry gold ore. Placer mines in the Rollinsville and Black Hawk districts recovered 13.01 fine ounces of gold and 2 ounces of silver. Fineness of the Black Hawk bullion when melted at the Denver Mint was 0.687½ gold and 0.148½ silver and fineness of the Rollinsville bullion was 0.817½ gold and 0.112½ silver.

Southern districts (*Black Hawk, Central City, Nevadaville, Russell Gulch*).—In 1929 lode mines in the northern districts produced less than one-half ton of ore, yielding only $245 in gold and 2 ounces of silver; therefore practically all the production from lode mines in the county is from the southern districts. The principal producing mines were the Kansas-Ophir-Phoenix and Prize groups, operated by the Quartz Hill Holding Co. from the Argo 4.16-mile adit, whose portal is at Idaho Springs; here, also, is the Argo mill, a custom mill controlled by the Quartz Hill Holding Co. For description of the mill see Idaho Springs district, Clear Creek County, page 936. The Kansas-Ophir-Phoenix group was closed about 1902; in 1927–28 the shafts were unwatered by drill holes and raises from the Argo adit. The second largest producer was the Chain O'Mines (Inc.), which operated "The Patch," Roderick Dhu, and San Juan properties at Nevadaville by shrinkage stoping and glory-hole mining, transporting the low-grade gold ore (with accompanying copper, lead, and zinc minerals) from the mouth of the La Cross Tunnel (adit) by trucks and by a 3,000-foot aerial tram to the amalgamation-gravity concentration-selective flotation-cyanidation mill, built just above the Colorado & Southern Railway station at Central City. Other producing mines were the Bullion, Champion, Coaley, Cousin Jack, Fairfield, Freiberg, Frontenac, Gold Cup, Gold Rock, Perrin, and Saratoga.

Northern districts.—A small quantity of gold bullion was sluiced or milled from the Perigo dump, near Rollinsville. At the Smuggler mine unwatering was done until October 22; to December 31 the shaft was sunk 65 feet. The property is opened by a 215-foot shaft, 2,130 feet of adit, a 150-foot winze, and 3,800 feet of drifts. The 25-ton 10-stamp amalgamation-table concentration mill was idle.

GRAND COUNTY

No production of metals was made in Grand County in 1929.

Elk Mountain district (*Hot Sulphur Springs*).—One hundred and seventeen feet of crosscuts was driven in 1929 on the Elk Mountain claims, 4 miles northwest of Hot Sulphur Springs, upon which more than 3,000 feet of adits had been driven before 1928.

La Plata (*Jones Pass*) *district* (*Empire*).—In 1929, 135 feet was driven on the drainage adit of the Helping Hand-Ready Cash group, a producer in the past of small lots of high-grade silver ore.

Monarch district.—No work was done at the Monarch copper prospects, 12 miles east of Granby, near the Boulder County line.

St. Louis Lake district.—Assessment work was done in 1929 on the Mount Vasquez Mines Co.'s property near St. Louis Lake at the head of St. Louis Creek.

Williams Fork district.—No work was done in 1929 on the Bobtail group at the head of Williams Fork; the group is opened by a 1,000-foot adit.

Wolverine district.—No work was done at the Wolverine group of silver-lead claims in the northeastern corner of the county, near the Jackson County line, 12 miles north of Grand Lake.

GUNNISON COUNTY

Domingo (*Goose Creek, White Earth*) *district* (*Madera, Powderhorn, Spencer, Vulcan*).—The Vulcan Consolidated Mines Corporation, lessee of the Good Hope-Vulcan group, which in 1928 built a small matting furnace and operated it unsuccessfully through February, 1929, on dump ore, in 1929 unwatered the Good Hope shaft and drove 250 feet of development work on the bottom level, resulting in the shipment of a car of copper-gold-silver ore to the Leadville smelter. Assessment work was done on the claims of the Great American group and Gold Pick group. The Great American is opened by a shaft (cleaned out in 1929) and the Gold Pick by a 575-foot adit. Assessment work was done on the Good Friday group.

Elk Mountains district (*Crested Butte*).—J. C. Bennett shipped a small lot of lead-silver-gold ore to the Leadville smelter. Martin Mufich did assessment work on his claims.

Galena Mountain district.—Assessment work was done at the Setz prospects (the Brooklyn and Harper groups) on Galena Mountain, near Schofield Pass, at the head of Rock Creek.

Gold Brick district (*Ohio*).—At the Carter Mines Co.'s property 1,000 feet of drifting was done in 1929. The 20-stamp amalgamation-gravity concentration-flotation mill was operated for a short time, yielding gold-silver bullion and a car of lead-silver-gold concentrates. A small lot of gold-silver ore was shipped from the Victory property to the Golden Cycle mill.

Quartz Creek district (*Pitkin*).—The Roosevelt adit was driven 682 feet in 1929, making it 5,200 to 5,300 feet long.

Rock Creek district (*Marble*).—Several cars of zinc-lead-copper-silver concentrates made from dump material at the Lead King mill in 1916 were shipped in 1929 to the Midvale (Utah) custom flotation mill. This property is opened by a 700-foot adit, which was cleaned out in 1929. There is on the property a 50-ton concentrating mill equipped with crusher, rolls, jigs, and two Wilfley tables. A 1-ton lot of lead-silver ore was shipped to Leadville from the Eagle-Lead Bullet group in sections 5 and 6, T. 12 S., R. 87 W., near Marble.

Taylor Park district.—At the old Enterprise mine at the head of Taylor Park on the east side of Taylor River on Tellurium Creek dump ore was milled in 1929, yielding 55 tons of lead-silver-gold-[zinc] concentrates. This property had been reopened and a flotation mill built in 1928.

Tin Cup district.—Some development was continued at the old Gold Cup adit with the object in view of finding ore in a block faulted from the old ore body.

Tomichi district (*White Pine*).—Four hundred tons of zinc-lead-copper-silver-gold ore from the North Star group was shipped to the Midvale (Utah) custom selective flotation mill.

HINSDALE COUNTY

Cimarron district (*Cimarron*).—At the Silver Jack group, at the head of Cimarron Creek, 470 feet of adit was driven in 1929, making the total length 747 feet.

Galena district (*Lake City*).—In August, 1929, the Highland Chief Lease completed a 150-ton gravity concentration-flotation mill to treat ores from the Empire Chief and Highland Chief groups on Henson Creek 14 miles west of Lake City. This mill, known as the Empire Chief, was operated one shift daily through August, September, and October. The ore treated in 1929 was from the Highland Chief; the product was lead-silver-gold-copper concentrates and zinc-silver-gold-copper concentrates. The equipment of the mill comprises 1 Universal crusher, 1 Marcy ball mill, 2 Card concentrating tables, 2 Minerals Separation flotation machines, 1 filter, and 3 thickening tanks. Development by the Highland Chief Lease in 1929 consisted of 1,886 feet of drifts and one stope 70 feet long by 120 feet high. The Empire Chief group is opened by 2 adits, one 680 feet and one 1,730 feet long; in 1929 development work consisting of approximately 1,000 feet of drifts, crosscuts, adit, and raises was done. Other producers in the Galena district were the Big Casino and Little Casino, from both of which zinc-lead-copper-silver-gold sulphide ore was shipped to the Midvale (Utah) selective flotation custom mill, and the Ocean Wave, from which lead-copper-silver-gold-[zinc] ore was shipped to the Leadville smelter. On the Big Blue group 40 feet of crosscut adit was driven. At the Ute and Ulay a 150-ton flotation mill was under construction on Henson Creek, 4 miles west of Lake City. The equipment consists of 1 crusher, 1 Marcy mill, 1 Dorr classifier, 2 Ruth 12-cell flotation machines, and 1 American 6-foot 4-leaf American filter. At the Pearl and Ruby group on Henson Creek, 15 miles west of Lake City, the Townsend Lead-Zinc Co. drove 300 feet of adit in 1929, making the total length 1,105 feet.

Lake district (*Lake City*).—Assessment work was done in 1929 on the Fanny Fern, Silver Leaf, Silver Queen, and other properties in the Lake district.

JACKSON COUNTY

At the Wolverine property near Pearl, from which copper ore was shipped in 1916 and 1917, development work was done in 1929; the property is opened by a 285-foot shaft and is equipped with a 50-ton gravity concentration mill. At the Village Belle property on Copper Ridge, in sections 7, 8, 17, and 18, T. 11 N., R. 78 W., 3½ miles from North Gate, annual assessment work was done in 1929; the property is opened by a 300-foot shaft and 600 feet of drifts.

JEFFERSON COUNTY

No work was done at the Baxter Gap or the Malachite property between Bear Creek and Mount Vernon Canyon.

LAKE COUNTY

In 1929 Lake County produced 125,014 tons of ore, yielding in terms of recovered metals gold, silver, copper, lead, and zinc, having a gross calculated value of $2,826,261, compared with 121,415 tons of ore and $2,903,122 in 1928 and with 141,075 tons of ore and $2,874,116 in 1927. The county also produced 411,344 tons of molybdenum ore, from which 3,320 tons of molybdenum sulphide concentrates containing 3,529,295 pounds of elemental molybdenum was made, and shipped 17,770 long tons of ferruginous manganese ore to steel mills.

LEADVILLE DISTRICT[3]

GENERAL FEATURES

In 1929 the metal production of Lake County, except molybdenum, came from the Leadville district.

Classification of Leadville ores in 1929, in terms of original content

	Ore		Original analysis							
	Percentage	Short tons	Gold	Silver	Copper (wet assay)	Lead (wet assay)	Zinc	Silica	Iron	Sulphur
			Ounces per ton	*Ounces per ton*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Sulphide:										
Siliceous (carrying sulphides).	3	3,701	0.194	3.51	0.13	0.11	0.32	(?)	(?)	(?)
Iron pyrites	1	1,144	.063	42.01	1.03	2.62	3.40	9.3	36.8	42.10
Lead (silica excess)	------	389	.318	9.79	.33	7.49	4.56	29.4	27.4	14.86
Lead (iron excess)	------	51	.004	28.43	------	7.25	8.88	16.0	26.1	23.35
Copper (silica excess)	------	196	.235	7.94	8.30	.51	------	(?)	(?)	(?)
Zinc-iron-lead (smelting)	4	5,449	.030	4.00	------	11.13	25.31	(?)	(?)	(?)
Zinc-iron-lead (milling: original heads).	72	89,681	.004	3.89	.17	6.18	20.29	9.8	25.0	(?)
	80	100,611	------	------	------	------	------	------	------	------
Oxide (including low-sulphur ores):										
Siliceous gold	1	1,594	1.334	10.81	1.60	1.95	2.82	39.4	21.0	.08
Siliceous silver (including old slags).	15	18,527	------	3.06	.07	3.25	3.99	31.0	30.1	1.48
Copper	------	31	.048	5.39	4.78	1.17	8.00	51.6	10.6	6.50
Lead (silica excess)	2	1,977	.190	4.68	------	9.57	3.19	44.1	17.8	2.65
Lead (iron excess)	2	2,274	.043	5.69	.05	11.34	2.57	22.1	33.3	1.44
	20	24,403	------	------	------	------	------	------	------	------
Metal (sulphide and oxide)	(1)	(1)	(1)	(1)	------	------	------	------	------	------
	100	125,014	------	------	------	------	------	------	------	------

[1] Specimen gold of less than one-half ton (actually 1,181 ounces) contained 866.64 ounces of gold and 231 ounces of silver.

Only one of the three furnaces of the A. V. lead bullion-leady copper matte smelter of the American Smelting & Refining Co. was operated in 1929. All the ores and concentrates treated in 1929 came from Colorado mines. As has been the situation for several years, this plant has had to depend in part on slag from old smelter dumps carrying a little silver and lead. The quantity of this slag used in 1929—18,503 tons—came from the American and Bi-Metallic old smelter dumps. The Western Zinc Oxide Co.'s Wetherill grate furnaces remained idle; this plant in the past purchased zinc carbonate ore as low as 14 per cent zinc and made a leaded-zinc oxide for the rubber trade.

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[3] For geology, history, and production see Emmons, S. F., Irving, J. D., and Loughlin, G. F., Geology and Ore Deposits of the Leadville Mining District, Colo.: U. S. Geol. Survey Prof. Paper 148, 1927, 368 pp.

The Colorado Zinc-Lead Co.'s 300-ton selective flotation mill was idle in January, 1929, and was taken over by the Leadville Zinc-Lead Co. After remodeling the plant the company operated it at 277 tons a day for 313 days. As in 1928, the mill handled chiefly zinc-lead-iron-silver-copper-gold sulphide ore from the Leadville Deep Mines Co. in 1929, but it also accepted similar ore from the Castle View, Henriett-Maid of Erin, Golden Eagle, Ibex, New Monarch, Resurrection, Silver Spoon, and Yak [Dolly B, Famous, Mosquito, Polaris, Rubie, White Cap] group of mines. The equipment of this mill on February 20, 1930, was as follows: 1 Blake 15 by 30 inch crusher, 1 Symons cone 3-foot crusher, 1 Traylor FB2 vibrator screen, 1 Stearns Roger 6 by 12 foot rod mill, 1 Colorado Iron Works 5 by 19 foot ball mill, 1 Dorr Model C classifier, 1 Colorado Iron Works classifier, 5 Deister concentrating tables, 3 Minerals Separation 12-cell flotation machines, 1 American 8-foot filter, 2 Dorr 20 by 30 foot thickening tanks, and 6 Wilfley 2-inch pumps. Zinc concentrates in 1929 averaged 52.2 per cent of zinc, 2.1 per cent of lead (wet assay), 3.4 ounces of silver, and 0.007 ounce of gold to the ton. Lead concentrates averaged 8.8 per cent of zinc, 45.4 per cent of lead (wet assay), 21.1 ounces of silver, and 0.027 ounce of gold to the ton. The zinc concentrates were shipped to the United States Zinc Co.'s Amarillo (Tex.) zinc retort plant, to the American Metal Co.'s Blackwell (Okla.) zinc retort plant, and to the National Zinc Co.'s Bartlesville (Okla.) plant. The lead concentrates went to the A. V. smelter.

As usual some of the ores mined at Leadville were shipped for treatment elsewhere. Specimen gold went to the Denver Mint; pyritic gold ores were shipped to the nonroast cyanidation department of the Golden Cycle mill at Colorado Springs; copper-silver-gold sulphide ore to Garfield, Utah; zinc-lead-silver sulphide ores to the pigment plant at Coffeyville, Kans.; and zinc-lead-silver-gold sulphide ores to the custom selective flotation plants at Bauer and Midvale, Utah.

MINES REVIEW

The Leadville Deep Mines Co., an operating, leasing, and unwatering enterprise, continued to extract ore and develop a consolidated group of mines on Carbonate Hill and in Graham Park, consisting of the company's Greenback claim and holdings of the Iron Silver Mining Co., the Western Mining Co., the Alleghany Mining Co., the Adams Mining Co., the Commerce Mining Co., the Empire Zinc Co., and the Mikado Lease. The Leadville Deep Mines Co. property yielded the bulk of the zinc-lead-silver-gold-iron sulphide and silver-gold-copper-lead-iron (called dry silver ore) sulphide ore of the district in 1929. Production in 1929 came from the Brookland, Clontarf, Cyclops, Emmet, Greenback, Hunkadori, Mahala, Moyamensing, Monte Christo, Venus, Wolftone, and Young America claims. Pumping, hoisting, and other operations are centered at two vertical shafts 1,357 and 1,390 feet deep. The details of the unwatering of this area are described in the reports of this series for 1925 and 1926. In 1929 development work totaled 6,641 feet of drifts and 1,505 feet of raises. In addition to supplying ore to the Leadville Zinc-Lead Co.'s mill, the Leadville Deep Mines Co. shipped some lead-silver-copper-gold sulphide ore to the A. V. smelter and some zinc-lead-[silver-gold] ore to the leaded-zinc oxide plant of the Ozark Smelting & Mining Co., of Coffeyville, Kans. Similar ore was shipped from the Henriett-Maid of Erin mine to Coffeyville.

In addition to the producing mines mentioned, other producers at Leadville were the A. Y. and Minnie, Chippewa, Climax, Dome, Fanny Rawlings, Highland Mary, Lilian, Luema, Morning Star, Evening Star, President, St. Louis Tunnel, Stone, Venir, and William Wallace. Ferruginous manganese ore was shipped to the steel mill at Pueblo from the Star group (Morning Star and Evening Star) and from the Stevens mine.

OTHER DISTRICTS

Alicante, Colorado Gulch, Lackawanna Gulch, Red Mountain, St. Kevin, and Sugar Loaf districts (north and west of Leadville).—No production was made from the mining districts in Lake County north and west of Leadville.

Arkansas River and tributaries placer districts.—No placer gold was recovered from gravels in Lake County in 1929.

Tenmile (Climax, Fremont Pass) district.—The Climax Molybdenum Co.'s mill at Climax, on Fremont Pass, in 1929 treated 411,344 tons of ore, which yielded 3,320 tons of molybdenite concentrates, containing 3,529,295 pounds of elemental molybdenum. Mining is by the shrinkage-stope system and caving.[4] New raises in 1929 totaled 2,562 feet. A new adit, 465 feet lower than the White adit, was in 872 feet at the end of 1929, and 381 feet of a 465-foot shaft was sunk to connect finally with the new adit. This adit, when completed, will be about 4,000 feet long and will cut under 25,000,000 tons of ore determined by diamond drilling. Practically the only minerals to be separated from the siliceous gangue are molybdenite and pyrite.[5] A new 500-ton addition to the mill was set in operation in November, 1929, and the total tonnage treated in December was 40,000 tons. As of July 14, 1930, the equipment of the 2,000-ton selective mill (893 tons daily average for 361 days in old unit and 662 tons daily average for 43 days in new unit in 1929) was as follows: A set of 20 by 54 inch Garfield rolls, a 24 by 36 inch Allis-Chalmers Superior jaw crusher, and a 4-foot Symons cone crusher, which crush the ore at the mine to one-half inch. At the mill are one 9 by 7 foot Marcy mill, two 6 by 10 foot Allis-Chalmers ball mills, three 6 by 6 foot Allis-Chalmers ball mills, six Model C Dorr classifiers, and one Model D 16 by 24 foot Dorr drag classifier, one Fahrenwald 10-cell flotation machine, one Minerals Separation 10-cell flotation machine, fourteen Callow flotation machines, one Oliver 4-foot filter, eight steam-heated 6 by 10 foot pans for drying molybdenite concentrates, and one 9 by 10 foot Dorr thickening tank.

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[4] Coulter, W. J., Mining Molybdenum Ore at Climax, Colo.: Eng. and Min. Jour., vol. 127, No. 10, Mar. 9, 1929, pp. 394–400.

[5] Coulter, W. J., Crushing and Concentrating Molybdenum Ore at Climax, Colo.: Eng. and Min. Jour., vol. 127, No. 12, Mar. 23, 1929, pp. 476–480.

The production at Climax from 1924 to 1929 has been as follows:

Molybdenum production at the Climax mill in Colorado, 1924–1929

	Elemental molybdenum (pounds)
1924 (5 months operation; idle 7 months)	156,935
1925	821,757
1926	1,057,367
1927	1,858,228
1928	2,957,845
1929	3,529,295
	10,381,427

LA PLATA COUNTY

Within the boundaries of La Plata County are the California (La Plata), Cave Basin, Needle Mountain, and Oro Fino mining districts. At Durango is the American Smelting & Refining Co.'s lead bullion and leady copper matte smelter, equipped with one blast furnace. It handles mainly concentrates but also whatever ore is offered from Dolores, La Plata, Ouray, San Juan, and San Miguel Counties, with occasional lots of ore from Mineral, Lake, and Eagle Counties. The smelter also owns the sulphating plant originally built there by the Complex Ores Recoveries Co. (or Read-Coolbaugh) in 1923 to remove the zinc from the Black Bear (Upper San Miguel district, San Miguel County) bulk concentrates; after the Black Bear operations ceased the American Smelting & Refining Co. acquired the sulphating plant and adjusted it to remove the zinc from other zinc-bearing material, particularly zinc-lead middlings from the Sunnyside mine at Eureka. The zinc sulphate produced has been sold in recent years as a sulphating reagent.

California (or La Plata) district (Hesperus, La Plata).—Seven mines in the California district produced 19,950 tons, of which the La Plata Mines Co. produced 19,863 tons. This company reports that operations in 1929 at the Gold King group 5 miles from May Day spur of the Rio Grande Southern Railroad were chiefly exploration and development, with mill operation incidental thereto. Development consisted of 1,232 feet of drifts, 92 feet of raises, and 89 feet of winzes. To the end of 1929 development in the mine totaled 3,007 feet of drifts, 916 feet of adit, 71 feet of crosscuts, 350 feet of raises, and 292 feet of winzes. The mill, called the La Plata, was originally built in 1908, but was remodeled in 1927–28 to a 250-ton selective flotation mill. It was operated in 1929 at a daily average of 54 tons for 365 days. As of January 1, 1930, the mill equipment was as follows: 1 crusher, 50 Allis-Chalmers (1,000-pound) stamps, 1 Denver Engineering Works 6 by 8 foot tube mill, 1 Colorado Iron Works 5 by 5 foot ball mill, 2 Akins 36 by 45 inch classifiers, 3 Wilfley No. 5 concentrating tables (for pilot work only on tailings), 3 Denver Sub-A 6-cell 18-inch flotation machines, 1 diaphragm flotation machine, 1 scavenger flotation machine, 1 Portland 2½-foot filter, and 1 Dorr 8-foot-diameter thickening tank. The ore treated in 1929 was from the Independence claim of the Gold King group. Concentration at a ratio of 27.41 to 1 yielded 723 tons of concentrates, averaging to the ton 7.16 ounces of gold, 104.78 ounces of silver, 5.46 per cent of lead, and 6.87 per cent of zinc. Other production in 1929 was a 1-ton lot of dry gold ore from the Duke, a 3-ton lot of dry silver ore from the Jumbo, a 1-ton lot of dry gold ore from the Lucky Moon, 61 tons of dry gold and silver ore from the May Day, a 2-ton lot of dry gold ore from the Mountain Lilly, and 19 tons of dry gold ore from the Idaho, all shipped to the Durango smelter. At the Mountain Meadow group 100 feet of adits, trenches, and shaft development work was done.

Mount Runlett (Cave Basin or Vallecito) district (20 miles north of Bayfield).—No work was done in the Cave Basin district in 1929. In 1928 a 3-ton lot of ore assaying 33 ounces of silver to the ton was shipped from the Silver Reef prospect.

Needle Mountain district.—Only assessment work was done in the Needle Mountain district in 1929. Prospects in this district are about 7 miles from the Needleton railroad station. On the Aetna is a 1,300-foot adit; on the Dawn of Hope group, a 300-foot adit; and on the New York, a 300-foot adit.

Oro Fino district.—Some development work was done in 1929 at the Oro Fino property, 17 miles north of Durango on Junction Creek near the Neglected mine.[6] The Neglected mine was once a producer of gold ore.

LARIMER COUNTY

In sections 31 and 32, T. 9 N., R. 73 W., in the Manhattan district, 33 miles west of Roberts spur on the Colorado & Southern Railway, the Cash Gold Mining Co. drove 125 feet of adit, 15 feet of drifts, and sank 25 feet of winze. To the end of 1929 development totaled 200 feet of adit, 30 feet of drifts, and 25 feet of winze.

MESA COUNTY

Sinbad district.—At the Precipice prospect, 65 miles southwest of Whitewater, 300 feet of adit was driven in 1929. The total reported development consists of two adits, one 310 feet long and one 450 feet long. Previous reports indicated an 80-foot shaft also.

MINERAL COUNTY

Creede district.—Seven mines in the Creede district in 1929 shipped 5,436 tons of ore containing 121.76 ounces of gold, 615,637 ounces of silver, 7,713 pounds of copper, 329,956 pounds of lead, and 62,291 pounds of zinc; 542 tons went to the Golden Cycle mill, and 4,894 tons went to the Durango and Leadville smelters. Producing mines were the Amethyst, Commodore, Equity, Happy Thought, New York-Last Chance-Del Monte, Pittsburg, and Ruth Elder. The lessee on the Amethyst drove 160 feet of drifts and 230 feet of raises and sank 102 feet of winzes. The lessee on the Commodore drove 470 feet of drifts and 225 feet of raises. The lessee on the Happy Thought drove a 150-foot raise. The Happy Thought is part of the Creede Mines (Inc.), which is opened by a 12,000 foot adit connecting with a 1,600-foot shaft. The lessee on the New York-Last Chance-Del Monte group drove 720 feet of drifts and 90 feet of raises and sank 70 feet of winzes. At the Equity, 7½ miles from Creede, no work was done in 1929, and the 20-ton flotation mill built in 1928 was idle; a 4-ton lot of crude ore was shipped to a smelter. At the Old Emma property, in the Royal Arch district 17 miles southwest of Creede, 225 feet of adit was driven in 1929, making the total length 500 feet.

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[6] Emmons, William H., The Neglected Mine and Near-By Properties, Durango Quadrangle, Colorado: U. S. Geol. Survey Bull. 260, Contributions to Economic Geology, 1904, pp. 121–127.

MOFFAT COUNTY

Douglas Mountain district.—A lessee on the Garfield-Bromide group in sections 9 and 16, T. 7 N., R. 101 W., shipped 51 tons of copper-silver oxidized ore to the Garfield smelter, Utah. The ore was trucked 106 miles north to the Union Pacific Railroad at Rock Springs, Wyo. The mine is opened by a 250-foot vertical shaft and 1,375 feet of drifts on three levels.

Timberlake Gulch district.—In doing assessment work on his placer claim in section 2, T. 10 N., R. 92 W., James Gooldy recovered by sluicing 7 crude ounces of gold bullion. When melted at the Denver Mint the bullion weighed 5.61 ounces and assayed 0.943¾ fineness gold and 0.054 fineness silver.

MONTEZUMA COUNTY

California district (see also La Plata County).—A lessee on the dump of the Sundown group, using a special amalgamating machine, saved gold bullion weighing 7.68 ounces. When melted at the Denver Mint the bullion weighed 7.30 ounces and assayed 0.952¼ fineness gold and 0.042½ fineness silver. Development work was done at the Euclid and the Lady Stafford groups.

OURAY COUNTY

Cow Creek district.—In the Cow Creek district, 12 miles from Ridgway, 180 feet of adit was driven on the Belmont prospect and 75 feet of adit on the Middy.

Red Mountain district.—Production from seven mines in the Red Mountain district in 1929 totaled 249 tons, from which were calculated as recovered metals 15.81 ounces of gold, 4,197 ounces of silver, 32,063 pounds of copper, and 39,475 pounds of lead, with a gross value of $10,694. Lessees on the Beaver-Belfast cleaned the workings and shipped 19 tons of lead-zinc-silver gold sulphide ore to Midvale, Utah. A lessee on the Governor dug out specimen gold assaying at the Denver Mint 0.729¾ fineness gold and 0.255½ fineness silver. The lessee on the Guadalupe drove 65 feet of drifts and shipped 65 tons of copper-silver sulphide and 3 tons of lead-silver sulphide ore to Tooele, Utah. At the Guston, an old property developed by a 1,210-foot shaft, 5,000 feet of drifts, and 2,600 feet of adit, a crosscut was driven 375 feet in new ground, and the old third, fourth, and fifth levels of the old workings were reopened; in addition 87 tons of lead-copper-silver-gold sulphide ore was shipped to Midvale, Utah. At the Yankee Girl, a former large producer, a lessee cleaned up 40 tons of copper-silver-gold sulphide ore, which he shipped in about equal lots to Garfield and Midvale, Utah. A 24-ton lot of copper-silver-gold sulphide ore was shipped from the Laura Dunmore to Tooele, Utah. A small lot of lead-copper-silver ore was shipped to Garfield, Utah, and a small lot of lead-[copper]-silver ore was shipped to Murray, Utah, from the San Antonio mine.

Sneffels district.—The Camp Bird Leasing Co. continued operation on the upper workings of the famous Camp Bird mine until April 1, when succeeded by the King Lease, which continued the work without interruption. The two groups operated both the mine and lessee's mill 365 days. The lessees in 1929 drove 750 feet of raises and 510 feet of drifts and crosscuts. The mill, built in 1927 in Imogene Basin at the mouth of the upper adit, was operated at a daily average of 16.4 tons. The flow sheet is as follows: Crushing in a 7 by 10 inch Blake crusher, grinding in a 4½ by 4½ foot Denver Engineering Works ball mill and a No. 54 Marcy ball mill, followed by plate amalgamation on six 4 by 16 foot copper plates, one Dorr Simplex classifier, and one spitzkasten classifier, to seven Wilfley concentration tables. The amalgam bullion assays 0.754 fineness gold and 0.236 fineness silver. The concentrates made are classified as dry gold, but carry some silver, lead, copper, and zinc. In addition, in 1929, dry gold and silver ore was shipped direct to the Leadville smelter and to the Golden Cycle mill.

Production on company account at the Camp Bird ceased June 30, 1916. The value of recovered metallic contents from May, 1902, the date of acquisition by the Camp Bird (Ltd.), to June 30, 1916, was $23,234,256, with profit at the mine and mill of $15,331,788. The total recovered value from this mine from 1896 to June 30, 1916, was $27,269,768 and the profit, $17,731,788. In December, 1916, the company began driving a lower adit beginning at the level of the mill and town site of Camp Bird, on Canyon Creek, 450 feet below the lowest workings. In 1918 the adit reached the vein 11,000 feet from the portal. In 1919 and 1920 the company drove drifts east and west from the adit and raised from the east drift to connect with the old workings, draining them of water. There has been no company development since 1920 and no ore extracted by the company since 1916, but lessees took an option on the upper levels in October, 1925, which resulted in creditable production in 1926, 1927, 1928, and 1929.

Lessees on the Trust-Ruby, near Sneffels, shipped to the Golden Cycle mill 20 tons of dry gold ore and to the Denver Mint two lots of gold-silver bullion, made by hand crushing, amalgamation, and retorting, which assayed, respectively, 0.648¾ fineness gold and 0.349 fineness silver and 0.650 fineness gold and 0.344 fineness silver.

Uncompahgre district (Ouray).—Several cars of dry gold and silver ore, carrying also a little zinc, lead, and copper, were shipped direct to the Leadville smelter from the American Nettie group. A 15-ton lot of dry gold ore was shipped from the Speedwell to the Golden Cycle mill. The Wanakah mill, as remodeled in 1927 by the Mutual Gold Mines Co., is equipped as follows: One Blake 12 by 20 inch crusher, six 4 by 5 foot amalgamation plates, one Marcy 3 by 8 foot rod mill, one Akins 3 by 10 foot classifier, one Colorado Iron Works 5 by 5 foot ball mill, and one Ruth 8-cell flotation machine. This mill, however, was idle in 1929 but was worked in 1928. The Sultan mill, at the mouth of Bear Creek, south of Ouray, remained idle in 1929. It was built in 1926 and is equipped as follows: One Blake crusher, one 5 by 6 foot Colorado Iron Works ball mill, one 3 by 22 foot Akins classifier, one Minerals Separation 12-cell flotation machine, one Portland 8 by 8 foot filter, and one Dorr 16-foot thickening tank.

PARK COUNTY

Park County, in 1929, produced metals valued at $221,204, in terms of recovered metals, of which $206,797 was gold.

Beaver Creek district (*Fairplay*).—Development work was done at the Shelton placer.

Buckskin district (*Alma*).—The Oklarado Mining Co., organized in 1928 to develop the Paris and Excelsior group in Buckskin Gulch and to develop a process for treatment of the oxidized ores, in 1929 operated experimentally 10 stamps of the 20-stamp amalgamation and flotation mill and yielded gold-silver amalgamation bullion. When melted at the Denver Mint the bullion assayed 0.688 fineness gold and 0.233 fineness silver. Early in 1930 the company became defunct. At the Sweet Home mine 700 feet of development work was done in 1929 and a narrow-gage car of copper-lead-[zinc]-silver-gold sulphide ore was shipped to the Leadville smelter. At the Criterion 150 feet of development work was done. At the Loveland Mountain prospect, opened by 4 adits 30, 40, 240, and 20 feet long, an 1,800-foot aerial tram was installed.

Consolidated Montgomery district (*Alma*).—At the Dolly Varden, opened by a 500-foot adit and 3,000 feet of drifts, development in 1929 consisted of 120 feet of raises, 70 feet of winze, and 100 feet of drifts, resulting in the shipment of a 14-ton lot of lead-[zinc]-silver oxidized ore to the Leadville smelter. Assessment work was done at the Juanita-May group. Lessees operated the Magnolia for three months but shipped no ore. At the Pirate property the Windsor Gold Mining Co. drove 54 feet on its main adit and also made surface open cuts. At the Sarsfield group 500 feet of adit was driven.

Freshwater district (*Guffey*).—Surface improvements were made at the Susannah property, and after the hoist and gallows frame was installed the 40-foot shaft was unwatered. At the Betty property, which has a 300-foot abandoned vertical shaft, assessment work was done in 1929.

Hall Valley district (*Webster*).—A 5-ton lot of lead-[zinc]-silver-gold ore was shipped to Leadville from the Rainbow prospect. Development was continued, but no ore was shipped from the La Clede-Missouri group, which has been an intermittent producer of copper-lead-[zinc]-silver-gold ore. In 1927 and in previous years ore from the La Clede-Missouri has contained bismuth, which at times has been made a part of the credit computation on the settlement.

Mosquito district (*Alma*).—During 1929 the London Gold Mines Co., operator of the London Extension group (owned jointly by the London Extension Mining Co. and the London Mining & Milling Co.) and of the London group (owned exclusively by the London Mining & Milling Co.), drove 5,087 feet of drifts and raises on the London group and extracted from the London Mother, Paris, Easton, and Allentown claims 1,278 tons of dry gold ore, containing 3.625 ounces of gold to the ton and also a little silver, lead, copper, and zinc, and drove 2,000 feet of development work on the London Extension group and extracted from the Flora A., Ibex Fraction, and Huron claims 1,661 tons of dry gold ore, containing 3.30 ounces of gold to the ton. The ore was shipped to the Leadville smelter and to the Golden Cycle mill. The Alma Mining & Milling Co., lessee on that part of the London and Paris claims above the North

London Tunnel and after November 1, 1929, above the South London Tunnel, ran for a time its North London flotation mill at the mouth of the Blanchard Tunnel adit, sometimes called the North London Tunnel, and shipped one car of lead-gold-silver concentrates. The London Gold Mines Co. operated both groups through the London Extension Tunnel adit, which is about 4,500 feet long. From the Orphan Boy 100 tons of ore containing 1.18 ounces of gold and 4.02 ounces of silver to the ton was shipped to the Golden Cycle mill. At the Champaign, opened by 2,000 feet of adits, 60 feet of exploratory driving was done in 1929. At the Oxide group, opened by a 425-foot adit, 25 feet of adit was run in 1929. No work was done at the Mascotte adit, which is 1,400 feet long.

PITKIN COUNTY

The total gross calculated value of gold, silver, lead, and zinc, in terms of recovered metals, in Pitkin County in 1929 was $155,609, compared with $160,778 in 1928. All the ore was shipped to smelters and was classified as follows: Lead-silver ore, 10,703 tons; zinc-lead-silver ore, 696 tons.

Avalanche Creek district (*Carbondale*).—At the Double Decker-Groundhog-Gypsum group, in the Spring Butte or Avalanche Creek district, 75 feet of adit and a 65-foot raise were driven; an aerial tram 500 feet long and a set of jigs (capacity, 4 tons in 8 hours) were installed. No work was done at the Janeway group, 15 miles from Carbondale.

Lincoln Gulch district (*Aspen*).—At the Hillside group, opened to the end of 1929 by a 130-foot adit, 240 shifts of work were done. At the Lincoln Gulch Metal Mines Co. 100 feet of adit was driven; development to the end of 1929 consisted of two adits totaling 450 feet. At the Ruby property $800 was spent in 1929 in cleaning out the upper workings to make them available for examination. At the Sailor Boy property, opened by a 300-foot adit, 15 feet was driven in 1929.

Roaring Fork district (*Aspen*).—All the production from Pitkin County came from mines at Aspen. The Smuggler Leasing Co. drove 300 feet of adit, 300 feet of raises, 500 feet of crosscuts, and 500 feet of sublevels and produced 6,781 tons of lead-silver oxidized ore, carrying 8.52 ounces of silver and 5.62 per cent of lead (wet assay) to the ton, from 20 to 40 per cent of lime, 11.5 per cent of silica, 3.6 per cent of iron, 2.4 per cent of zinc, and 2.7 per cent of sulphur, and 636 tons of zinc-lead-silver sulphide ore. Production by the Smuggler Leasing Co. was from the Smuggler, Durant, and Late Acquisition groups. The Spar Consolidated Mines Co. shipped 2,185 tons of lead-silver oxidized ore, carrying 5.23 ounces of silver and 6.7 per cent of lead (wet assay) to the ton, and 24 per cent of silica, 2.9 per cent of iron, 1.3 per cent of zinc, and 2.7 per cent of sulphur. The Continental Divide Development Co., lessee of the Cowenhoven adit and the Della S group, drove 600 feet of drifts and 800 feet of raises and shipped 802 tons of lead-silver ore, carrying 17.64 ounces of silver and 9.12 per cent of lead to the ton, and 24.1 per cent of silica, 8.5 per cent of iron, 4.7 per cent of zinc, and 4.4 per cent of sulphur. Other producers of somewhat similar limy lead-silver ore were the Durgen, Percy La Salle, and Pioneer. The Park Tunnel Mining, Milling & Leasing

Co. drove 100 feet of drifts and raises on its property, opened by a 3,100-foot adit, and shipped 485 tons of lead-silver oxidized ore, carrying 22.7 per cent of silica, 32.7 per cent of iron, 1.5 per cent of zinc, and 1 per cent of sulphur. In August the Midnight Mining Co. made connection with the shaft workings of the Midnight mine by a 360-foot raise from its 6,700-foot adit. Zinc-lead-silver ore was disclosed. Construction of a 50 to 75 ton selective flotation mill was begun in November. One carload of ore shipped to Leadville from the Midnight carried 54 ounces of silver and 6.4 per cent of lead (wet assay) to the ton, 62.6 per cent of silica, 6.3 per cent of iron, 1 per cent of zinc, and 6.8 per cent of sulphur.

The Smuggler 400-ton jigs-tables-vanners concentration mill (last operated in 1926) remained idle. It was originally built in 1888. The equipment as of February, 1929, was as follows: 1 Blake crusher, 4 trommels, 3 Huntington pulverizers, 2 screens, 2 Roger rolls, 4 Hardinge tube mills, 10 Frue vanners, 20 Hallett concentration tables, and 6 German-made jigs. At the Hope adit, which starts on Castle Creek and runs 6,500 feet (11,000 feet of workings in all) northeasterly toward the Little Annie shaft, a flotation mill was completed early in July, but with other surface buildings was burned down on the first day it was operated.

RIO GRANDE COUNTY

South Mountain district.—For 10 months of 1929 the Marian Mining & Milling Co.'s 50-ton flotation mill was operated at a rate of about 30 tons a day on dry gold ore, containing also silver, lead, copper, and zinc, from the Miser-Guadalupe group at Jasper on South Mountain. The equipment of the mill consists of 1 Universal crusher, 1 Ruth 5 by 9 foot rod mill, 1 Dorr classifier, 1 Deister-Plato concentrating table, 1 Ruth 12-cell flotation machine, and 6 settling tanks. The concentrates produced in 1929 at a high ratio of concentration were lead-copper-[zinc]-silver-gold concentrates, containing a relatively high content per ton of gold, silver, and lead.

Summitville district.—Lessees on the Little Annie mine at Summitville drove 450 feet of drifts and 280 feet of raises and winzes, and shipped 140 tons of ore containing 909.38 ounces of gold and 194 ounces of silver. This mine, an important producer in the seventies and an occasional producer after 1880, was reopened in 1926 by a lessee who had known for 20 years of an extraordinary outcrop of gold which lay in an unworked part of the property. In 1926, 21 tons of quartz containing free gold yielded 5,118.02 fine ounces of gold. In 1927, 137 tons of ore returned $117,826.49 in cash after hauling, freight, and treatment costs were deducted. In 1928 returns were $212,942.62 after freight and treatment were deducted.

ROUTT COUNTY

Copper Spur district.—The Cole Mining & Milling Co. cleaned old workings for examination of the Copper King property near Yarmony. There is a 500-foot inclined shaft on the property.

Hahns Peak district.—In 1929 the Primary Industries Corporation sank 320 feet of shaft on the Master Key property, at Columbine.

SAGUACHE COUNTY

The total gross calculated value of metals estimated as recovered from ore mined in Saguache County in 1929 was $1,241,209, compared with $1,438,048 in 1928.

Blake district (*Mirage*).—The small mill equipped with a 5-ton Chilean mill and Wilfley table, built at the Bob Lee claim in 1928, was not operated in 1929.

Crestone district.—A lessee on the Osage claim at Crestone sent 4 tons of gold ore to the Golden Cycle mill. Jefferson Bros., of Crestone, shipped a 4-ton lot of gold ore to the Golden Cycle mill from the Sunset claim.

Kerber Creek district (*Bonanza*).—The Rawley Mines (Inc.) 350-ton flotation mill on Squirrel Gulch, a tributary of Kerber Creek, near Bonanza and 18 miles from Villa Grove, was operated steadily at a daily average of 325 tons in 1929. Mine operations were also continuous. On December 20, 1928, the Rawley Mines (Inc.), a subsidiary of the American Smelting & Refining Co., leased the Antoro, Paragon, and Michigan mines, adjacent to the Rawley group. Development work in 1929 totaled 5,852 feet. The mill is at the portal of the Rawley 6,600-foot adit, and the lead-copper-iron-silver-gold-[zinc] sulphide concentrates are carried by a 7¼-mile aerial tramway northward over the divide to Shirley station, on the Denver & Rio Grande Western Railroad Salida-Montrose narrow-gage branch, for shipment to Salida; at Salida the concentrates are transferred to broad-gage cars for movement to the A. V. smelter at Leadville. The mill was remodeled in 1926 and has been operated under the present management six months in 1926 and all of 1927, 1928, and 1929. Prior operations ceased December 1, 1923. The equipment of the mill is as follows: 1 Allis-Chalmers No. 5-K gyratory crusher, 1 Allis-Chalmers 54 by 24 inch set of rolls, 2 Hardinge 8 by 2½ foot conical ball mills, 2 Dorr 6-foot classifiers, 2 Minerals Separation 12-cell flotation machines, 4 Allen (total 39 cells) flotation machines, 1 Oliver 6-foot and 1 Oliver 8-foot filter, and 2 Dorr thickening tanks, one of which is 50 by 12 feet. The new flume and tailings dam were in operation in 1929.

Little development was done, and only small production was made from other properties in the Kerber Creek district. None was done on the Bonanza-Cocomongo group, owned by the St. Louis Smelting & Refining Co. A 5-ton lot of lead-copper-[zinc]-silver-gold ore was shipped to the Leadville smelter from the Golden Wave claim by the Joe Wheeler Mining & Development Co. A 28-ton shipment of similar ore was made to the Leadville smelter from the Vienna mine.

Orient district (*Villa Grove, Mineral Hot Springs*).—On the eastern side of the San Luis Valley, east of Villa Grove and Mineral Hot Springs, is the Colorado Fuel & Iron Co.'s Orient iron mine, from which iron oxide ore goes to the company's iron and steel mill at Pueblo.

SAN JUAN COUNTY

Animas district (*Silverton*).—The area in the immediate vicinity of Silverton and east of the Animas River from Silverton to Middleton has long been known as the Animas district, but mining districts have no legal status to-day and the boundaries were never definite. In this area producing mines in 1929 were the Aspen, Belcher, Buffalo

Boy, Highland Mary, King, Lackawanna, Lark, Little Fannie, Mayflower, Melville of the Iowa-Tiger group, and Pride of the West.

In 1928 the Shenandoah-Dives Syndicate, which owns the Shenandoah, Dives, Dives Fraction, Slide, Terrible, and Mayflower groups, moved its base of operations from the Dives-Shenandoah group, in which it had blocked out ore, to the more accessible Mayflower group, with the intention of driving a long drift to the Shenandoah-Dives. Gold-copper ore found in the Mayflower changed somewhat the plan of operations. The syndicate rented the 40-year old building of the Iowa Gold Mining Co. (in Arrastra Gulch), set within it a new milling plant of modern machinery for use as a pilot mill, and connected the Mayflower to the mill by an aerial tram. The remodeling was done in the first half of 1928; thereafter ore taken out in development of the Mayflower was milled at a daily average of 95 tons. In May, 1929, the syndicate was incorporated as the Shenandoah-Dives Mining Co. Development work at the Mayflower in 1929 consisted of 692 feet of drifts, 708 feet of raises, 224 feet of new crosscuts, and 374 feet in enlarging of old work. The Iowa mill was operated at a rate of 90 tons daily for 355 days, treating 28,858 tons of Mayflower ore and 3,421 tons of Iowa group ore. A new 300-ton flotation mill was almost completed during the year on the west side of Animas River opposite Arrastra Gulch, and the new mill and mine were connected by a 1.25-mile aerial tram. The new equipment was in operation in February, 1930. The equipment of the Iowa mill, in Arrastra Gulch, is as follows: 1 Denver Engineering Works 11 by 18 inch crusher, 1 Stearns Roger 18 by 18 inch trommel, 1 Stearns Roger 6 by 5 foot ball mill, 1 Dorr Simplex 3½ by 14 foot classifier, 3 Wilfley tables, 1 Minerals Separation 14-cell 18-inch flotation machine, 1 Dorr 2½ by 6 foot filter, and 1 Dorr 10 by 17 foot thickening tank. Concentrates from the Mayflower in 1929 were gold-silver-copper-lead-[zinc].

The Colorado Mexico Mining Co., lessee on the Iowa-Gold Tiger group, drove 700 feet of drifts in 1929 and shipped ore over its aerial tram to the Iowa mill, remodeled by the Shenandoah-Dives Co. The Lackawanna 50-ton concentration mill was operated for a short time on ore from the Lackawanna mine. The Pride Mining Co., which had built in 1928 a 65-ton flotation mill at the Pride of the West mine, in Cunningham Gulch 3 miles from Howardsville, operated the mine and mill from March 1 to June 1, 1929. Both were idle until the latter part of October, after which the Altamont Mining Co. operated to December 31. The equipment of the mill is as follows: 1 Blake crusher, one 3 by 8 foot trommel, 1 Allis-Chalmers ball mill, 1 Dorr classifier, 3 Wilfley tables, 1 Fahrenwald 8-cell flotation machine, 1 Oliver filter, and 1 Dorr thickening tank. Concentrates produced in 1929 were gold-silver-copper-lead-[zinc].

The Vertex Mining Co., a subsidiary of the Tonopah Mining Co., did no development work on the Buffalo group in 1929; the mine is opened by a 2,000-foot adit and a 400-foot inside shaft (winze) from the adit. The year was spent in the construction of a 100-ton flotation mill and aerial tram, which were completed December 1; the mill was operated experimentally in December. The equipment of the mill is as follows: 1 Blake 10 by 16 inch crusher, 1 Marcy 10 by 6 foot ball mill, 1 Dorr 3-foot classifier, 1 Wilfley table, 1 Minerals

Separation 8-cell flotation machine, 1 Dorr filter, and 1 Dorr 12-foot thickening tank.

The concentrates produced in 1929 were gold-silver, carrying no copper, lead, or zinc, and averaging 9.6 per cent of silica, 40.6 per cent of iron, and 39.6 per cent of sulphur.

At the Little Fannie 150 feet of drifts and 50 feet of raises were driven, and a car of lead-silver-gold ore was shipped to Durango. Shipments from the Aspen, Belcher, Highland Mary, King, and Lark consisted of one car or less each of lead-silver-gold smelting ore to Durango. The Hamlet mill in Maggie Gulch was idle. Its equipment consists of 1 crusher, 1 ball mill, 10 concentrating tables, 1 eight-cell flotation machine, and 2 thickening tanks. The Little Nation mill at Howardsville was idle. The mill, built in 1924, is equipped with 1 crusher, 1 rod mill, 4 concentrating tables, 1 flotation machine, and 2 filters.

Eureka district (*Eureka, Silverton*).—The Eureka district appears to include all the area from Red Mountain to Animas Forks west of the Animas River. In 1929 the only operating mine was the Sunnyside, worked by the Sunnyside Mining & Milling Co., a subsidiary of the United States Smelting, Refining & Mining Co. The mine is on Hanson Peak; the portal is at an altitude of 13,200 feet and is connected by a 16,000-foot aerial tram with the 1,000-ton selective flotation mill at Eureka on the Silverton Northern Railroad. Development work at the mine in 1929 totaled 6,320 feet of shafts, adit, drifts, and raises; the mine and mill were operated continuously except for time lost for repairs. This company was one of the first (in 1917) in the United States to use selective flotation in the treatment of a complex low-grade zinc-lead-copper-iron-silver-gold sulphide ore. The present mill was built in 1917, and the practice as of 1926 was described by Robie.[7] The capacity of the present mill has been enlarged from time to time from 500 tons a day to 1,000 tons rated capacity in 24 hours. In 1929 the daily average treated was 900 tons. As of February 4, 1930, the equipment was as follows: 2 Gates No. 6–K gyratory crushers (at the mine), 2 Farrel 13 by 30 inch jaw crushers, 3 Denver Engineering Works 5 by 14 and one 5 by 8 foot tube mills, 3 No. 86 Marcy 15 by 8 foot ball mills, 7 Dorr duplex classifiers, 11 No. 6 Wilfley tables (for control), 1 Minerals Separation 10-cell 24-inch Sub A, 1 Minerals Separation 10-cell 24-inch Standard, 1 Minerals Separation 22-cell 24-inch Standard, 1 Minerals Separation 16-cell 24-inch Standard, and 1 Minerals Separation 6-cell 24-inch Sub A flotation machine, 1 Oliver 4 by 14 foot filter, 1 Portland 9 by 12 foot filter, 1 Portland 3½ by 12 foot filter, and 3 Dorr thickening tanks (one 8 by 25 foot, one 10 by 28 foot, and one 8 by 15 foot). Products from the mill in 1929 were high-grade zinc concentrates, carrying also lead, copper, silver, and gold, which were shipped to the United States Zinc Co.'s retort plant at Amarillo, Tex. (residues from the zinc retorts going to El Paso, Tex.); high-grade lead-copper concentrates, carrying much more than half the total recovered gold and silver, which were shipped to the Durango smelter; a small tonnage of iron-zinc-lead-silver-gold concentrates; and a still smaller tonnage of zinc-lead middlings. The middlings and iron concentrates were shipped to the

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[7] Robie, E. H., Selective Lead-Zinc Flotation at Sunnyside: Eng. and Min. Jour., vol. 121, 1926, pp. 542, 757–762.

Read-Coolbaugh sulphating plant at the Durango smelter, where the soluble zinc sulphate produced by the roasting was leached out and the residue sent to the lead furnaces. Much of the zinc sulphate is sold as a chemical reagent for use in flotation plants.

SAN MIGUEL COUNTY

The mines of San Miguel County in 1929 produced only 17,951 tons of ore, which yielded in terms of recovered metals gold, silver, copper, and lead valued, at average yearly prices, at $303,697, compared with $1,312,017 in 1928. The closing of the Smuggler-Union mine on December 11,1928, caused the heavy decrease.

Iron Springs district (*Ophir*).—The Ophir district in 1929 produced 17,436 tons of ore, yielding in terms of recovered metals $5,048 in gold, 113,364 ounces of silver, 34,034 pounds of copper, and 2,382,826 pounds of lead, with a total gross calculated value of $221,579, compared with $303,834 in 1928. The principal producing mine was the Carbonero. It is opened by a crosscut adit 2,200 feet long. Mining is done from levels above the adit. In 1929, 500 feet of drifts were run on the fifth and sixth levels. The ore of this mine as milled carried about 9 per cent of lead and 7 ounces of silver to the ton and was the highest grade strictly lead ore milled in the State. The mill was operated continuously at a rate of 40 tons a day; the product was high-grade silver-lead concentrates. The equipment of the mill is as follows: 1 Universal No. 3 crusher, 1 Ruth 3 by 9 foot rod mill, 1 Deister rougher table, 3 Deister pilot tables, 1 Ruth 8-cell flotation machine, and 4 settling tanks. Development work on the Butterfly-Terrible mine totaled 750 feet of drifts and 400 feet of raises. The mill, built in 1928, was operated 45 days in 1929 at a rate of 50 tons a day. Its equipment consists of 1 Allis-Chalmers gyratory crusher, 1 vibrating screen, 1 Colorado Iron Works 5 by 6 foot ball mill, 1 Akins classifier, 2 Deister tables, 2 Fahrenwald 6-cell flotation machines, 1 American 3-leaf filter, 2 agitation tanks, and 1 Dorr 18-foot thickening tank. The product was lead-copper-silver-gold concentrates. Other producers in 1929—the Deadwood, Montezuma, New Dominion, Shoemaker, and Silver Tip—shipped small lots of smelting ore. The San Bernardo mine and mill remained idle in 1929. The equipment of the mill consists of 1 Gates gyratory crusher, 2 Allis-Chalmers 6 by 5 foot ball mills, 1 Dorr duplex classifier, 1 Minerals Separation 12-cell flotation machine, 1 American continuous filter, and 1 agitation tank.

Lower San Miguel district (*Sawpit*).—No development was done or production made from gold-silver-lead-zinc prospects in the Lower San Miguel district in 1929. The vanadium properties, closed in 1920, remained idle.

Upper San Miguel district (*Telluride*).—There was no mining in the Upper San Miguel district in 1929. The Smuggler-Union mine and mill closed December 11, 1928, and the only production in the district was clean-up material from the Alta, Smuggler-Union, and Tomboy.

SUMMIT COUNTY

The total gross calculated value of metals recovered from Summit County lode and placer mines in 1929 was $239,819, compared with $391,008 in 1928.

Breckenridge district.—The total gross value of the combined output of lode and placer mines in the Breckenridge district in 1929 was $233,715. From May 4 to September 30 a ¼-yard gasoline-propelled power shovel dug 6,000 yards of stream and bench gravels at the Bemrose-Bostwick placer in Hoosier Gulch near Hoosier Pass. Placer ground in this property totals 446 acres. The length of ditches owned totals 4 miles. Production in 1929 was 74.55 crude ounces of amalgam bullion. When melted at the Denver Mint the bullion weighed 74.52 fine ounces and assayed 0.807 fineness gold and 0.178 fineness silver. In May, 1929, the Continental Dredging Co. purchased the dredge boat formerly owned by the Blue River Placer Mining Co., spent the summer repairing the dredge, and operated from October 1 to December 31, 1929. During that period the electrically driven dredge, equipped with 90 buckets, each with a capacity of 7 cubic feet, dredged about 400,000 yards and recovered 2,372.80 crude ounces of gold, which when melted at the Denver Mint weighed 2,371.96 ounces and assayed 0.785 fineness gold and 0.201½ fineness silver. From June 1 to October 1 Frank W. Stafford sluiced the Louis D-Emile placer and recovered 30.85 crude ounces, which when melted at the Denver Mint weighed 29.83 fine ounces and assayed 0.712 fineness gold and 0.218 fineness silver. Sluicing on the Old Solid Gold placer recovered 30.82 crude ounces, which when melted at the Denver Mint weighed 30.73 fine ounces and assayed 0.666½ fineness gold and 0.178 fineness silver. Small lots of placer gold were sluiced from the Berlin and Fraction placers. The Fraction bullion when melted assayed 0.764½ fineness gold and 0.231½ fineness silver.

Two narrow-gage cars of lead-silver-gold smelting ore were shipped to the Leadville smelter from the lode mine covered by the "86" placer claim. An 8-ton lot of lead-silver-gold smelting ore from the Flag and a 10-ton lot of lead-silver ore from the Fredonia were shipped to the Leadville smelter. At the Royal Tiger mine 782 feet of drifts, 648 feet of raises, and 21 feet of crosscuts were driven in 1929. The mill was operated experimentally and produced gold-silver amalgam bullion and lead-copper-[zinc]-gold-silver concentrates. The equipment of the mill as of February 27, 1930, was as follows: 1 Blake 9 by 15 inch crusher, 3 Traylor vibrating screens, 2 Traylor 27 by 14 inch rolls, 1 Denver Engineering Works 27 by 14 inch roll, 3 classifiers, 1 Wilfley table, 5 Forrester flotation machines, 1 Portland filter, and 1 Dorr and 1 Traylor thickening tank.

The Wellington Mines Leasing Co., which took over the operation of the Wellington mine April 1, 1927, and completed and operated a 125-ton selective flotation mill from August 23 to November 28, 1927, and from July, 1928, through December, ran only January, February, and to March 10, 1929, when operations ceased. Later in the year the Royal Tiger Mining Co. bought the mine and mill but did not operate the property in 1929. During the period of operation the Wellington mill was run at a daily average of 116 tons on zinc-lead-silver-gold sulphide ore. Products were zinc-lead-silver and lead-silver-gold concentrates. The equipment of the mill consists of 1 Blake 9 by 15 inch crusher, 1 Mine & Smelter Supply Co.'s 16 by 36 inch roll, 1 Stearns Roger 6 by 5 foot ball mill, 1 Dorr Model D classifier, 4 standard Wilfley tables (for pilot only), 2 Minerals Separation 12-cell 18-inch Sub A flotation machines, 1 American 6-foot 5-leaf filter, 1 homemade 14-foot 25-inch-diameter revolving drum dryer, 1 Dorr thickening tank, and 1 V thickening tank. Zinc concentrates were sold to the U. S. Zinc Co.'s retort plant at Amarillo, Tex., and the lead concentrates were shipped to the A. V. smelter at Leadville.

Montezuma district.—A 4-ton lot of lead-silver ore from the Bullion, a 1-ton lot of lead-silver ore from the Louis Dunnon, and a 19-ton lot of lead-silver ore from the Sutton were shipped from Montezuma in 1929 to the Leadville smelter.

Ten Mile district (Frisco, Kokomo, Robinson).—A 4-ton lot of lead-silver-gold ore from the Axtell group at Kokomo, a 6-ton lot of silver-lead-gold ore from the "Four-Most" at Frisco, a 14-ton lot of lead-silver-gold ore from the Etta M at Frisco, and an 18-ton lot of silver ore from the Silver Queen at Kokomo were shipped to the Leadville smelter. A 95-ton lot of zinc-lead-silver ore from the Whitman mine at Kokomo was shipped to the Combined Metals Co.'s selective flotation mill at Bauer, Utah.

TELLER COUNTY

Mine and dump siliceous sulpho-telluride gold ores, mill slags, clean-ups, and stolen specimen gold from the Cripple Creek district aggregated in recovered gold to United States mints and to smelters 127,711.64 fine ounces, valued at $2,640,034, compared with $3,059,181 in 1928, and 9,244 ounces of silver, compared with 18,841 ounces in 1928.

In 1929 the Golden Cycle mill, at Colorado Springs, held exclusively the market for Cripple Creek ores. The Portland-Independence mill at Victor closed down December 1, 1928. Smelters can not compete for the siliceous ores of Cripple Creek.

The Golden Cycle mill continued to accept Cripple Creek ores containing under 0.20 ounce gold, or $4 per ton calculated at its payment of $20 an ounce, at $1.75 per ton treatment charges; in December, 1928, freight charges were reduced from $0.75 to $0.50 per ton on ore up to $4, inclusive. The rates of December, 1928, were not changed in 1929.

Cripple Creek treatment rates, Golden Cycle mill, December, 1928

Ore up to $4 per ton, inclusive	$1.75 plus $0.50 freight.
Ore up to $5 per ton, inclusive	$1.75 plus $0.75 freight.
Ore up to $8 per ton, inclusive	$2.25 plus $1 freight.
Ore up to $10 per ton, inclusive	$4 includes freight.
Ore up to $15 per ton, inclusive	$5.25 includes freight.
Ore up to $20 per ton, inclusive	$6.25 includes freight.
Ore up to $25 per ton, inclusive	$6.60 includes freight.
Ore up to $30 per ton, inclusive	$6.90 includes freight.
Ore up to $40 per ton, inclusive	$7.50 includes freight.
Ore up to $100 per ton, inclusive	$8.60 includes freight.
Ore over $100 per ton	$5.50 plus $3.10 freight unless released.

Payment: $20 an ounce for gold.

The flow sheet of the main Golden Cycle mill for treatment of Cripple Creek ores has not been materially changed since its last description by Blomfield and Trott.[8] The ore goes to a sampling mill and then to storage bins for different classes of ore. The classes formerly were determined by calcium oxide content.[9] The ore from the storage bins is divided between 1 Hardinge ball mill and 5 Schmidt Kominuters operating in closed circuit with Hum-mer screens. The screen undersize goes to 9 coal-fired 115 by 15 foot Edwards Duplex roasters. The roaster product goes to 7 Evans-Waddel 6-foot Chilean mills grinding in the alkaline-cyanidation mill solution. Each Chilean mill is followed by 2 blanket concentrating tables, and the tailings from the blanket tables go to 15-foot Dorr Bowl classifiers. The sand product of the classifiers goes to eleven 50 by 6 foot leaching tanks using a countercurrent decantation leaching system. Sand tailings are flushed to the tailings dump. The slime product from the classifiers goes to the slime leaching plant using thickeners and agitators. The development and application of the Golden Cycle "Superthickener" (now called Hardinge Superthickener or Clarifier) in the slime leaching plant has been described by Noel Cunningham.[10] Tailings from the slime plant are filtered on 2 stationary 86-leaf Moore filters. Gold solution from both leaching plants is clarified, deoxidized in a Crowe vacuum system, and precipitated in Cascade-type zinc boxes. Merrill zinc presses are used in the clean-up.

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[8] Blomfield, A. L., and Trott, M. J., Roasting for Amalgamating and Cyaniding Cripple Creek Sulpho-Telluride Gold Ores: Trans. Am. Inst. Min. Eng., vol. 60, 1919, pp. 118-132; The Golden Cycle Cyanide Plant: Chem. and Met. Eng., vol. 19, No. 12, 1918, p. 796.

In 1927, at the Golden Cycle plant, a separate 40-ton nonroasting all-sliming unit consisting of a sampler, a Marcy ball mill, Dorr classifier, and Dorr thickener and agitating tanks was installed to treat siliceous and sulphide ores from Colorado districts other than the Cripple Creek district. In 1928 ores received from other districts in Colorado were gold tellurides and gold siliceous and sulphide ore from Boulder County; sulphide gold ores and concentrates from Clear Creek, Gilpin, and Lake Counties; specimen gold ore from Rio Grande County; and silver oxidized ore from Creede, Mineral County. Treatment rates on these ores as of October 30, 1928, were as follows:

Treatment rates for miscellaneous gold and silver ores at the Golden Cycle mill, Colorado Springs, Colo., October 30, 1928

Ore up to and including $10 per ton	$3.00
Over $10 and including $15 per ton	3.50
Over $15 and including $20 per ton	4.00
Over $20 and including $40 per ton	5.00
Over $40 per ton	5.50

The above rates are exclusive of freight charges.

$20 per ounce paid for gold when settlement value is 0.03 ounce per ton or more.

Pay for silver as quoted on market, day of settlement, excluding fraction of cents:

	Per cent silver value
Containing 1 ounce and including 5 ounces	50
Over 5 ounces and including 10 ounces	65
Over 10 ounces and including 20 ounces	75
Over 20 ounces and including 50 ounces	85
Over 50 ounces and including 100 ounces	90
Over 100 ounces	95

When containing both gold and silver, ores containing 20 ounces silver or over, $1 per ton will be added to treatment rates.

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[9] This system was discarded in 1928 or previous to 1928. See Dycus, M. F., Ore Treatment Methods and Practice in the Golden Cycle Mill: Min. Cong. Jour., vol. 15, No. 12, December, 1929, pp. 965-968.

[10] Cunningham, Noel, The Golden Cycle Superthickener and Clarifier: Eng. and Min. Jour., vol. 119, No. 22, May 30, 1925, pp. 905-907.

In 1929 the combined average daily tonnage treated at the two mills of the Golden Cycle was 813 tons.

MINES REVIEW

Mineral Hill.—Lessees in 1928 shipped 160 tons of gold ore from the Plutocrat prospect. In June of that year work on the prospect ceased. No work was done in 1929. The development on the property consists of a 200-foot vertical shaft, 700 feet of drifts, and a 90-foot adit.

Carbonate Hill.—The Jay Gould Mining Co. in 8 months of 1929 sank the Kittie Wells shaft 85 feet and drove 60 feet of drifts. Development consists of a 240-foot vertical shaft and 200 feet of drifts.

Poverty Gulch.—A considerable tonnage of ore was shipped from the El Paso-Gold King dump. Lessees on the dump of the C. O. D. shipped several hundred tons of ore.

Hoosier Pass.—The Cudahy Mining Co. drove 1,000 feet of crosscuts and drifts on the Hoosier property. The Hoosier shaft is 860 feet deep.

Tenderfoot Hill.—The Dictator Gold Mines cleaned out the Sangre de Christo adit (1,900 feet long) and shipped 40 tons of ore during a 4-month bond and lease.

North Slope of Ironclad Hill.—The Oston Leasing Co. drove 787 feet of development on the Jerry Johnson and shipped 6,252 tons of ore. The Damon (Axtel) and W. P. H. groups of the United Gold Mines Co. shipped 557 tons and 4,960 tons, respectively. The Queen Metals Co. operated the Forest Queen about six months and shipped ore containing 989 ounces of gold. The mine was then idle until January 1, 1930. This property is opened by a 900-foot vertical shaft and 1,000 feet of drifts on nine levels.

Gold Hill.—Dump ore was shipped from the Matoa. At the Index, opened by a 1,100-foot vertical shaft, 300 feet of development work was done and 491 tons of ore was shipped. On the Midget-Bonanza King lessees drove 500 feet of development work and shipped 5,165 tons of ore.

Raven and Guyot hills.—Producing mines were the Cresson, Doctor-Jack Pot dump, Elkton, Jo Dandy, Katinka dump, Mary McKinney, Moose dump, Sheriff, and Queen. The annual report of the Cresson Consolidated Gold Mining & Milling Co. for the 12 months ended August 31, 1929 (dated January 10, 1930), says:

> During the year 118,075 dry tons of ore were shipped of a gross value of $902,513.62, averaging $7.64 per ton; the returns, less transportation and treatment, were $498,372.16, giving the ore a net value of $4.22 per ton. The company received as additional income the sum of $8,244.25 interest on bank deposits, making a grand total of $506,616.41, with total expenses of $457,183.59, resulting in a net gain from operations of $49,432.82. The total cost per ton of ore produced was $3.87. This is a decrease of $1.17 per ton over 1928.
>
> You will note in our company's production of 118,075 dry tons, with an average return of $4.29 per ton, our entire cost was $3.87 per dry ton, resulting in a net profit of 42 cents per ton.
>
> Total cash at the close of the fiscal year ending August 31, 1929, was $345,839.41.

Costs at the Cresson mine, fiscal year ended August 31, 1929

	Per ton
General expense	$0. 007
Taxes	. 052
Insurance	. 109
Salary, officers	. 078
Colorado Springs office	. 076
Mining operations (including mine management and engineering)	3. 481
School Section and Dante	. 059
Depreciation	. 008
	3. 870

The development work for the year has been much more extensive, in comparison, than stoping. It has resulted in opening ore of good value but not large stopes.

Following is a summary of development work for year ending August 31, 1929:

Development

	Feet
Drifts and crosscuts	7, 360
Raises and winzes	1, 080
Prospecting—diamond drilling	291
Total	8, 731

In the year of 1929 the pumps were taken out and all levels below the 17, Roosevelt Tunnel level, were abandoned.

A large tonnage of ore was mined from these lower levels, but being low grade, the added cost of pumping and mining made the profit small.

Near the contact on 16, 15, 14, and 13 levels a new body of ore is being mined, which should show some profit, even with the large amount of development being done.

The large ore house dump is being equipped to load. There should be some profit in this.

The School Section, on which lease was taken last year, was found unprofitable, and the lease abandoned.

These operations were included in Cresson cost of mining. The total cost of ore shipped shows a decrease, being $5.04 in 1928 and $3.87 in 1929. This decrease is accounted for in measure by reserve tonnages being shipped.

Total production, Cresson Consolidated Mining & Milling Co., Colorado, 1903 to December 31, 1929

Period	Dry short tons	Gross value	Freight and treatment	Net value	Average gross value per ton	Average net value per ton	Dividends
1903 to Aug. 31, 1928	1, 647, 465	$30, 976, 159. 91	$9, 044, 575. 45	$21, 931, 584. 46	$18. 81	$13. 32	$12, 125, 072. 50
Sept. 1, 1928, to Aug. 31, 1929:							
Company ore	118, 075	902, 513. 62	404, 141. 46	498, 372. 16	7. 64	4. 22	
Lessee ore—							
Dante	36	315. 61	147. 54	168. 07	8. 77	4. 67	
School Section	733	7, 823. 56	2, 593. 02	5, 230. 54	10. 67	7. 14	
1903 to Aug. 31, 1929	1, 766, 309	31, 886, 812. 70	9, 451, 457. 47	22, 435, 355. 23	18. 05	12. 70	12, 222, 672. 50
1903 to Dec. 31, 1929	1, 794, 140	32, 129, 662. 33					12, 293, 432. 50

At the Elkton 302 feet of drifts were run, and 16,653 tons of ore was shipped. The Mary McKinney was worked on company account for five months in 1929 under the name of the LeClair Mines Co. Lessees worked all year. The Mary McKinney Co. was reorganized in October, 1929, and the name was changed to the LeClair Consolidated Mines Co. Shipments of ore were made throughout 1929.

The Queen Exploration Co. in 1929 drove 2,800 feet of development work and shipped 14,234 tons from the Queen group. This property was idle between August, 1929, and March, 1930. On the Sheriff lessees drove 100 feet of drifts.

Beacon Hill.—Producing mines were the El Paso, Gold Dollar, and Requa Savage dump. The Hartman & Clifford lease, which produced from the surface of the El Paso in 1927 and 1928, was canceled April 1, 1929.

Bull Hill.—Producing mines on Bull Hill were the Big Banta, Blue Bird dump, Dante, Gold Pinnacle, Gold Sovereign dump, Los Angeles, and Trail. The Cresson Co. worked the Dante. The Mexican Gold & Silver Mining Co., a lessee on the Gold Pinnacle, did 686 feet of development work in 336 days of 1929 and shipped 1,971 tons of ore. The Ophir Mining Co. and Virginia Consolidated Lease on the Gold Pinnacle drove 450 feet of drifts and crosscuts and shipped 25 tons of ore. The Stratton Lease Co. drove 4,200 feet of development in 1929 on Stratton Estate mines and shipped 7,202 tons of ore.

School Section 16.—The Cresson Consolidated Gold Mining & Milling Co., lessee, shipped 495 tons from one of the Blocks of School Section 16, T. 15 S., R. 69 W. The Kyner Leasing Co. drove 500 feet of drifts in 1929 and shipped 816 tons from one of the Blocks of School Section 16. These properties lie between Cameron and Altman.

Between Altman and Goldfield.—Producing mines between Altman and Goldfield were the Acacia, Deadwood, Empire Lee, Findley, Free Coinage dump, Pharmacist dump, Theresa, Victor dump, and Vindicator. At the Acacia, opened by a 340-foot shaft and 3,000 feet of drifts, 25 feet of shaft sinking and 20 feet of drifting was done in 1929; lessees shipped 283 tons of ore. The shipments from the Empire Lee were drawn from old stope fills. At the Free Coinage, opened by a 550-foot vertical shaft and 4,000 feet of drifts, 300 feet of drifts were run in 1929, and 574 tons of dump ore was shipped. The Deadwood, Theresa, and Vindicator were worked by the United Gold Mines Co.

Battle Mountain.—Producing mines were the Granite and Portland-Last Dollar, Rose Nicol, and Strong dump. Development work at the Granite consisted of 1,373 feet of drifts, 841 feet of crosscuts, 65 feet of winzes, a total of 2,279 feet. The Granite is opened by a 2,000-foot vertical shaft.

The thirty-sixth annual report of the Portland Gold Mining Co., for 1929 (dated February 17, 1930), says:

> The results of the operations of your property during the past year have been very disappointing. Not only was the operation carried on at a loss, but our failure to open any new ore of consequence makes the outlook for the future very disheartening.
>
> The mine superintendent has covered the results of our development program very completely in his report. It must be borne in mind in this connection that the Portland is a very old mine—its life up to date having been approximately four times that of the average productive gold mine. As a result, the maintenance of the workings is a large factor in the expense, and, further, all drives into new territory are hampered by the delay and expense necessary to get through the caved area of the older workings.
>
> Every economy possible in the operation has been practiced and every area which promised possibilities and which could be reached with the limited funds we had at hand has been explored to as great an extent as possible. We have repeatedly opened new ore bodies of great promise when first encountered, but

with two or three exceptions the ore bodies found were not extensive enough to repay the cost of the drives. Some of these areas still have possibilities, but our development program has had to be curtailed because of lack of funds.

For some time we have been attempting to dispose of the mill, the sale of which should return sufficient cash to take care of our present obligations, which are approximately $70,000, but up to date we have not received any acceptable offer.

The financial condition of the company as indicated by the treasurer's report is extremely serious, especially in view of our ore situation. If we are to continue operations on company account, it will only be possible through the immediate sale of the mill equipment or by securing additional loans. Realizing on the mill equipment under the present conditions is impossible, and it does not seem advisable to your board to attempt to borrow more money to carry forward a losing operation.

The only other alternatives that present themselves are either for the stockholders to submit to a voluntary assessment, the enlisting of outside capital, or the naming of a receiver. The first course has been repeatedly attempted with negative results by other Cripple Creek companies. As to the second, this report is accompanied by a proposal from the Golden Cycle Corporation which offers the only feasible solution of the situation, as I view it. The offer of an exchange of stock of the United Gold Mines Co. would result in the stockholders of the Portland having stock in a company which has and is paying an occasional dividend.

The other alternative of appointing a receiver to handle the affairs of the company and to liquidate its assets would be a prolonged and not particularly remunerative process.

Perhaps the most significant change effected during the year was the electrification of the No. 2 hoist, of which intention you were advised last year. Your company already possessed the necessary electrical equipment and a very material saving is realized as a result of the change. Other equipment and surface workings remain unchanged; however at the present time disposition of waste rock is becoming a greater problem in that short haul dumping space is now less available. Lessees continue to prosecute work on the various dumps of the company and their operation yields a satisfactory return.

THE INDEPENDENCE MINE

Early in February the lessees holding permits to prospect underground territory of the property discontinued their efforts, after which operations were completely suspended.

PORTLAND NO. 1 SHAFT

A greater number of lessees are now prospecting in this shaft of your property. Favorable progress is being made, and three sets of lessees are working in ore. There has been no development work during the year on company account through this shaft.

EXPLORATION PORTLAND NO. 2 SHAFT

1,100-foot level.—The work on this level consisted of 196 feet of crosscutting and 70 feet of drifting. This work was done to prospect the area above the Strong vein system which was encountered on 1,700 and mined to a point over 1,600. The conditions existing on this level will justify further development. However, due to a policy deemed necessary by your board, development work on all levels has been discontinued with the exception of one or two machines which are drifting in ore.

1,700-foot level.—Considering the amount of development work done within the past year on this level the results were disappointing as only one short stope was found which is now being mined. Ore opened in 1928 on this level has permitted a steady production during the year. A total of 1,488 feet of drifting and 1,113 feet of crosscutting was completed on the level.

1,800-foot level.—The development in this territory consisted of 510.5 feet of drifting and 558 feet of crosscutting and from which work two stopes resulted, one of which has been exhausted. These stopes will connect with the Strong stopes on the 1,700-foot level.

2,100-foot level.—1,580 feet of work was completed on this level, which work was credited as follows: 949 feet of drifting, 561 feet of crosscutting, a 48-foot winze, and 22 feet of raising. This development resulted in the locating of the West No. 1 and West No. 2 stopes. Both of these stopes are depleted at this time; however it was the ore opened on this level which disclosed the possibilities of 2,300 level.

2,300-foot level.—This level has far excelled any other in recent production of really satisfactory ore and is still yielding a substantial tonnage. The development work consisted of 303.5 feet of drifting, 498 feet of crosscutting and 10 feet of raising.

2,400-foot level.—The results from our efforts on this level, which consisted of 184 feet of crosscutting and 156 feet of raising, were not very encouraging; however present conditions reflect possibilities and further prospecting is recommended.

2,600-foot level.—This operation has been a good producer during the past year and is still producing some very good ore; however no new ore has been exposed as a result of development which consisted of 157 feet of drifting and 225 feet of crosscutting.

2,900-foot level.—953 feet of work was completed which was credited as follows: 226.5 feet of drifting, 614.5 feet of crosscutting, and 112 feet of raising. The development work as a whole was not encouraging with the exception of the East No. 3 stope. This stope has produced a substantial tonnage, and work continues in good ore.

3,000-foot level.—61 feet of development work was completed and credited as follows: 24.5 feet of drifting and 36.5 feet of crosscutting. Although some values were encountered no ore of commercial grade resulted.

Production.—From Portland and on company account, we shipped 28,909 dry tons; average value, $11.61. From this property lessees shipped 7,250 dry tons; average value, $8.67. Total tons shipped, 36,159.

Water.—The quantity of water pumped from the Portland mine continues practically unchanged.

LAST DOLLAR MINE

From this property the lessees shipped 6,481 dry tons; average value, $10.42. During February the company ceased shipments from the Last Dollar property. The Stratton Lease continues to hoist through this shaft.

The Portland Gold Mining Co. of Wyoming

OPERATIONS FOR THE YEAR 1929

Gross value of ore produced and shipped		$467,754.75
Total cost of mining and milling		557,554.41
Loss from operation of mines		89,799.66
Net profit from mill		1,161.61
Total loss from operation of mines and mill		88,638.05
Other income:		
Interest received	$301.90	
Exchange and discount	.73	
Dividends received from other companies	1.25	
		303.88
Total loss before depreciation and depletion		88,334.17
Depreciation	52,436.18	
Depletion	31,071.16	83,507.34
Total loss to surplus		171,841.51
Surplus:		
Balance January 1, 1929		397,005.31
Add: Profit on sale of equipment fully depreciated		14,657.94
		411,663.25
Deduct: Net operating loss for 1929, as above		171,841.51
Balance December 31, 1929		239,821.74

CASH RECEIPTS AND DISBURSEMENTS

Balance January 1, 1929		$40,379.02
Receipts:		
Bills collectible	$32,604.31	
Sale of assets	14,657.94	
Interest received	282.45	
Insurance	1,073.53	
Operations	344,201.22	
Dividends	1.25	
Notes payable	10,807.09	
Miscellaneous items	702.64	
Total receipts	404,330.43	404,330.43
		444,709.45
Disbursements:		
Vouchers and pay checks	443,408.97	
From mill store house fun	432.73	
Miscellaneous	.30	
Total disbursements	443,842.00	443,842.00
Balance December 31, 1929		867.45

BALANCE SHEET, DECEMBER 31, 1929

Assets:		
Cash		$867.45
Accounts receivable		574.69
Stores inventory		8,848.59
Fixed assets:		
Mines and lands		4,215,266.39
Mill		1,078,388.22
Permanent equipment		651,669.69
Investments in securities		104,293.37
Prepaid insurance and deposits		4,132.07
Total		6,064,040.47
Liabilities:		
Notes payable	$36,854.54	
Accounts payable	20,888.19	
Accrued taxes	10,385.73	
Miscellaneous items	2,807.94	
		70,936.40
Reserves:		
For depreciation	1,335,545.61	
For depletion	1,417,736.72	
		2,753,282.33
Capital:		
Capital stock paid up	3,000,000.00	
Surplus	239,821.74	
		3,239,821.74
Total		6,064,040.47

Statement of ore production of the Portland properties from April 1, 1894, to December 31, 1929

	Net tons	Gross value
From Apr. 1, 1894, to Dec. 31, 1928	6,119,717	$61,153,686.63
From Jan. 1, 1929, to Dec. 31, 1929	42,640	467,754.75
Grand total of ore production to date	6,162,357	61,621,441.38

Total dividends paid to Jan. 1, 1930, $11,992,080.

Statement of all work on Portland properties to January 1, 1930

	Total during 1929, in feet	Total prior to 1929, in feet	Grand total, in feet
Drifts	3, 942. 5	173, 678. 5	177, 621. 0
Crosscuts	4, 001. 5	155, 696. 5	159, 698. 0
Raises	407. 0	33, 719. 0	34, 126. 0
Winzes	124. 0	6, 913. 5	7, 037. 5
Shafts	-----------	13, 818. 5	13, 818. 5
	8, 475. 0	383, 826. 0	392, 301. 0

Total for Portland mine, 74 miles, 1,581 feet.
Total (not included above) for Independence mine, 17 miles, 1,917.5 feet.

United Gold Mines Co.—The annual report of the United Gold Mines Co., an operating and holding company for property scattered throughout the Cripple Creek district, says:

The production for 1929 was smaller in tonnage and net returns, but operating profit was larger.

The development work done was almost exactly the same as previous year. This work has opened several bodies of ore on the Vindicator, Trail, Patti Rosa, and Findley.

The Maud Helena claims were purchased by treasury stock. This ground, lying east and north of the principal ore body now being mined, will be developed soon.

The Fairview claim was equipped with ore house and the shaft sunk 100 feet deeper. This ore was in a basalt dyke and has not proven up on lower level. The drifting north and south is being continued as there should be other ore bodies.

From the Dillon shaft, through which the Bonanza claim is being worked, some work was done on the Portland and about 65 feet of medium grade ore found. This part of the Portland is leased to your company.

The Patti Rosa ore shoot has not been explored so that no definite size or value can be given it.

A bond and lease was obtained on group of claims on Copper Mountain. A large low-grade body of gold ore has been mined there. A number of shallow shafts have opened a vein which contained high-grade lead and zinc values. This vein is being opened by tunnel. A short crosscut will prove whether it is desirable to do any more work.

Operating statement, United Gold Mines Co., 1929

Receipts:	
Company ore sales	$289, 761. 35
Royalties	64, 835. 22
Miscellaneous earnings	11, 528. 59
Interest received	2, 807. 18
Crusher No. 1 gain	1, 155. 78
Crusher No. 2 gain	344. 66
Air sales gain	195. 38
	370, 628. 16
Expenses:	
Cripple Creek office	2, 000. 78
Colorado Springs office	3, 562. 21
Officers' salaries	5, 100. 00
Fairview, mining expense	20, 291. 28
Bonanza, mining expense	71, 464. 51
Trail, mining expense	52, 530. 68
Copper Mountain lease, mining expense	2, 165. 39
Vindicator, mining expense	115, 660. 66
Miscellaneous properties, mining expense	4, 451. 09
Mine owners' association expense	576. 00

Expenses—Continued.

Fire insurance	$60.00
Taxes, State and county	9,321.43
Taxes, Federal	5,515.88
Gain from operations	77,928.25
	370,628.16

Profit and loss—recapitulation—United Gold Mines Co., 1929

Investments removed from assets:[1]		
424,200 shares Uintah Tunnel	$7,851.50	
819,500 shares Magnolia	1,195.00	
132,666 shares Comanche Plume	2,018.98	
50 shares Londonderry	5,000.00	
	16,065.48	
Bad debts charged off	1,148.18	
Operating accounts	292,699.91	
Depletion sustained	35,270.71	
Depreciation sustained	1,729.12	
Dividends	44,052.17	
Recoveries on bad debts		$807.81
Adjustment of surplus reserves		1,144.00
Income accounts		370,628.16
Unclaimed accounts		2.05
Net balance to surplus		18,383.55
	390,965.57	390,965.57

[1] These investments resulted in acquiring property.

Total production of United Gold Mines property to December 31, 1929

	Net tons	Gross value
Ore mined before consolidation	26,310	$456,806
Production under operations of the United Gold Mines Co	792,912	9,885,518
Total to Dec. 31, 1929	819,222	10,342,324

Production of the United Gold Mines Co.—Company ore in 1929

Group	Net tons	Gross value	Company ore cash receipts	Average gross value per ton
Big Banta	1,885	$9,276	$4,138	$4.92
Trail	2,738	83,672	65,495	30.56
Bonanza	9,214	160,030	110,585	17.37
Fairview	1,025	21,333	13,905	20.82
Pauper	110	393	54	3.56
Rose Nicol	968	3,774	1,489	3.92
Vindicator	15,345	148,025	94,095	9.65
Total, company	31,285	426,503	289,761	13.61

Production of the United Gold Mines Co.—Lessee ore in 1929

Group	Net tons	Gross value	Royalties received	Lessees' receipts	Average gross value per ton
Axtel	557	$22, 278	$4, 880	$12, 601	$40. 00
Bonanza	262	8, 413	3, 248	3, 223	32. 10
Coriolanus	125	446	13	109	3. 58
Deadwood	312	1, 266	45	224	4. 06
Dexter	96	333	14	92	3. 47
Hardwood	146	4, 089	690	2, 337	27. 99
Montrose	262	3, 133	212	1, 469	11. 96
Poorman	80	482	24	215	6. 02
Trachyte	18	89	4	20	5. 00
Theresa	5, 292	82, 345	25, 498	29, 434	15. 56
Vindicator	14, 452	108, 174	27, 395	34, 713	7. 49
W. P. H	4, 960	38, 714	1, 519	16, 525	7. 81
Shurtloff	108	437	18	156	4. 05
Trail	1, 253	7, 108	1, 172	2, 263	5. 68
Findley	231	709	21	155	3. 07
Economic Dump	56	895	83	478	15. 95
Total, lessee	28, 210	278, 911	64, 836	104, 014	9. 91

Development of the United Gold Mines Co. in 1929

	Feet
Big Banta	474
Bonanza	937
Copper Mountain	155
Fairview	879
Last Effort	173
Pauper-Findley	205
Rose Nicol	182
Trail	1, 698
Vindicator	3, 449
Vindicator lessees	2, 008
	10, 160